REPORT OF PROCEEDINGS

OF THE

EIGHTEENTH ANNUAL CONVENTION

OF THE

AMERICAN RAILWAY

Master Mechanics' Association

IN CONVENTION AT

WILLARD'S HALL,

WASHINGTON, D. C.,

June 16th, 17th and 18th, 1885.

CINCINNATI:
ALDINE PRINTING WORKS.
1885.

AMERICAN RAILWAY

MASTER MECHANICS' ASSOCIATION.

OFFICERS FOR 1885-86:

PRESIDENT,

DAVIS BARNETT, of Port Hope, Ont.

FIRST VICE-PRESIDENT,

WILLIAM WOODCOCK, of Elizabethport, N. J.

SECOND VICE-PRESIDENT,

J. JOHANN, of Springfield, Ill.

TREASURER,

GEORGE RICHARDS, of Boston, Mass.

SECRETARY,

J. H. SETCHEL, of Dunkirk, N. Y.

REPORT.

The Eighteenth Annual Convention of the American Railway Master Mechanics Association was held at Willard's Hotel, Washington, D. C., June 16, 17, and 18, 1885. First Vice-President, J. Davis Barnett, presiding.

THE PRESIDENT—Will the Convention please come to order? The Rev. Doctor Byron Sunderland will invoke the divine blessing on our gathering.

PRAYER.

DR. SUNDERLAND—Almighty and everlasting God, in whom we live and move and have our being. Thou hast caused us to flourish in wondrous times, when the mind of man has conquered so many elements of nature, and with the lightning speed of travel of engines has brought the ends of the earth together. And so great companies of men consort together to consider their design and their labors and to rejoice in the triumphs of their genius. Be graciously pleased, Almighty Father, to regard with thy favor this Convention of sturdy men, who come here first of all to acknowledge thee, and to that spirit of the law which has given them great understanding, since they have interests in their hands and have a mighty task still to accomplish, because Thou hast made them men of strength and skill and genius. May the flame that leads from Thee, and evermore kindles the intellect of man, never burn low within them. May they continue to be the captains of great enterprises and the leaders of a mighty nation in all the arts which economize time, and distinguish the great age in which we live. Keep them with their wives and their daughters safely here while they are absent from their homes and loved ones, and follow with Thy blessing all the works of their hands according as they trust in Thee. Through Jesus Christ our Lord, Amen.

THE PRESIDENT—The Hon. James B. Edmunds, President of the Board of District Commissioners of the District of Columbia, is kindly with us to bid us welcome to Washington. I beg to introduce the Hon. James B. Edmunds.

MR. EDMUNDS—Mr. President, Ladies and Gentlemen: Of all the conventions that have honored the City of Washington by their presence, I know of none, whether scientific, professional or political, who are better entitled to the consideration and welcome of our people than the American Railway Master Mechanics'. It is not so much that you came here in your own carriages, drawn by your own horses that you are distinguished, as by the fact that your genius and labor have produced the conveyances that bring all conventions and all congresses that assemble in Washington, and thousands of people besides, and make this great city, with its prosperity and numberless comforts possible, and give it permanency as a national capital Many a time have I beheld an assembly that commanded my complete respect and even veneration for its learning and wisdom, its magnanimity of intellect or heart, but never until now have I had the honor to stand before a congress of magicians whose wondrous works in reality have outrivalled the tales of Oriental imagination and even revolutionized the conditions of human existence. Beginning with Savory and James Watt, followed by Fulton, Stevenson, and the other master mechanics, your fraternity have, with matchless skill, sought out and seized upon the secret sources of nature that for ages were hidden from the knowledge of man, and harnessing her powerful forces to your cars, you have gone forth like mighty giants to possess the earth. Your contests have not been for dominion over your fellow man through fields of blood, but for his material welfare, to assert his dignity, and the godlike supremacy of mind over matter. You have crossed continents and fought battles with time and with distance, stopping neither for river nor mountain, and, like the Titans of old, have scorned all adversaries less than the Infinite. With your progress, the earth has seemed to shrink beneath your feet, so that states and cities that were distant are brought into neighborhood relations, and yet in such magical manner that no intermediate possession has been lessened, but all have been multiplied in value and in usefulness. Indeed, you and your brother magicians, the master me-

chanics of navigation, have with your machinery, seized upon this huge globe itself, and shrunk its two years' circumference into an eighty days' circuit. At the same time, you have marvelously enlarged the earth's capacity for human existence, with improved conditions. Swifter, safer, cheaper travel and transportation have brought the peoples of the world together and into a better acquaintance, have lead them into a greater mutual dependence and brotherly regard, have banished national famines from the world and promoted peace among men. Yet none better than yourselves, know that there are still other victories to be won, other laws to be discovered, other forces in nature and in mechanics to be conquered, and you, the American mechanics, ever stand in the very front ranks of battle, determined to be the first to unfurl the flag of triumph and success in the provinces that lie beyond, and when you assemble for consultation to consider the new problems that may arise, you are assured of the sympathy and the good wishes of all who realize that your achievements are among the highest triumphs of modern science and civilization, and by none is this fact more keenly appreciated than by the intelligent people of this national capital, who are keenly alive to everything that pertains to human progress or to the welfare or honor of America, and it is in their behalf that I have the honor to extend to you all a most cordial welcome. [Applause.]

THE PRESIDENT—The Secretary will now call the roll.

The Secretary called the roll and announced that seventy-four full members had either answered to their names or were known to be in the city, and two associate members.

MEMBERS PRESENT AT ROLL CALL.

NAME.	ROAD.	ADDRESS.
BRYAN, H. S	Chicago & Iowa	Aurora, Ill.
BOON, J. M	New York, West Shore & Buffalo	Frankfort, N. Y.
BUSHNELL, R. W	Burlington, Cedar Rapids & Northern	Cedar Rapids, Ia.
BOYDEN, G. E	New York & New England	Boston, Mass.
BARNETT, J. DAVIS	Midland	Port Hope, Ont.
BLACK, JOHN	Cincinnati, Hamilton & Dayton	Lima, O.
BISSETT, JOHN	Wilmington, N. C	Florence, S. C.
BRIGGS, R. H	Chesapeake & Ohio Southwestern	Elizabethtown, Ky.
BRIGHAM, L. L	Passumpsic	Lyndonville, Vt.
BROWNELL, F. G	Burlington & Lamoille	Burlington, Vt.
BLACKWELL, CHARLES	Norfolk & Western	Roanoke, Va.
CAMPBELL, JOHN	Lehigh Valley	Delano, Pa.
COLBY, G. H	Boston & Albany	Boston, Mass.
CHAPMAN, N. E	Midvale Steel Co . . . . 333 Walnut St.,	Philadelphia, Pa.
CHAPMAN, THOS. L	Chesapeake & Ohio	Richmond, Va.
CLARK, DAVID	Lehigh Valley	Hazleton, Pa.
COOPER, H. L	Lake Erie & Western	Lafayette, Ind.
COOK, JAMES	Danforth & Cook's Locomotive Works	Paterson, N. J.
COOK, JOHN S	Georgia	Augusta, Ga.
COOK, ALLEN	Chicago & Eastern Illinois	Danville, Ill.
DEVINE, J. F	Wilmington & Welden	Wilmington, N. C.
EVANS, EDWARD	Cincinnati, Washington & Baltimore	Chillicothe, O.
EDDY, H. W	Boston & Albany	Springfield, Mass.
ECKFORD, JAMES	New York, Chicago & St. Louis	Bellevue, O.
EASTMAN, A. G	Southeastern of Canada	Farnham, Ont.
ENNIS, W. C	Yew York Susquehanna & Western	Wortendyke, N. J.
FULLER, WILLIAM	New York, Pennsylvania & Ohio	Cleveland, O.
FINLAY, L		Little Rock, Ark.
FOSTER, W. A	N. & M. Div. Fitchburg	Fitchburg, Mass.
GATES, G. W	Western of North Carolina	Salisbury, N. C.
GRIGGS, ALBERT	Providence & Worcester	Providence, R. I.
GORDON, H. D	Philadelphia, Wilmington & Baltimore,	Wilmington, Del.
GRAHAM, CHARLES	Lackawanna & Western	Kingston, Pa.
GORDON, JAMES T	Concord	Concord, N. H.
GRAHAM, J. S	Lake Shore & Michigan Southern	Buffalo, N. Y.
GILMORE, W. L	Lake Shore & Michigan Southern	Cleveland, O.
HINMAN, M. L	Brooks Locomotive Works	Dunkirk, N. Y.
HEADDEN, JOHN	Rogers Locomotive Works	Paterson, N. J.
HARDING, B. R	Raleigh & Gaston	Raleigh, N. C.
HODGMAN, S. A	Lobdel Wheel Works	Wilmington, Del.
HAGGETT, J. C	Dunkirk, Allegany Valley & Pittsburg	Dunkirk, N. Y.
HOWISON, N. W	Cumberland & Penn	Mt. Savage, Md.
HATSWELL, T. J	Flint & Pere Marquette	E. Saginaw, Mich.
JOHANN, JACOB		Centreville, Ia.
KINSEY, J. I	Lehigh Valley	Easton, Pa.
LAUDER, J. N	Old Colony	Boston, Mass.
LEECH, H. L	No. 1 Rollins St.,	Boston, Mass.
LANNON, WM	House of Representatives	Washington, D. C.
LEWIS, W. H	Delaware, Lackawanna & Western	Kingsland, N. J.
MEEHAN, JAMES	Cincinnati, N. Orleans & Texas Pacific	Ludlow, Ky.

NAME.	ROAD.	ADDRESS.
McCUNE, J. C	Sonora	Guy Mass, Mexico.
McGLENN, JAMES	Carolina Central	Laurinburg, N. C.
McCRUM, J. S	Missouri River, Fort Scott & Gulf	Kansas City, Mo.
MORRELL, J. E	Chicago, Rock Island & Pacific	Davenport, Ia.
MONTGOMERY, WM	New Jersey Southern	Manchester, N. J.
PAXSON, L. B	Philadelphia & Reading	Reading, Pa.
PETRIE, IRA	Jacksonville & Southeastern	Jacksonville, Ill.
PENDLETON, M. M	Seaboard & Roanoke	Portsmouth, Va.
PERRIN, P. J	Taunton Locomotive Works	Taunton, Mass.
PRESCOTT, G. W	Toledo & St. Louis . . . . 25 S. 4th St.,	St. Louis, Mo.
PORTER, J. S	Indiana, Bloomington & Western	Sandusky, O.
ROSS, GEO. B	No. 112 Liberty St.,	New York City.
ROBERTS, E. M	Ashland Coal & Mining Co	Ashland, Ky.
STONE, W. A		Norwich, Conn.
SMITH, HOWARD M	Virginia Midland	Alexandria, Va.
SPRAGUE, H. N	E. K. Porter & Co	Pittsburg, Pa.
SCHLACKS, HENRY	Illinois Central	Chicago, Ill.
SMITH, W. T	Kentucky Central	Covington, Ky.
STRODE, JAMES	Northern Central	Elmira, N. Y.
STEARNS, W. H	Connecticut River	Springfield, Mass.
SHAVER, D. O	Pennsylvania	Pittsburg, Pa.
SETCHEL, J. H	Supt. Brooks' Locomotive Works	Dunkirk, N. Y.
SMITH, WM	Boston & Maine	Boston, Mass.
STEVANS, G. W	Lake Shore & Michigan Southern	Cleveland, O.
SELBY, W. H	Wabash & St. Louis	Moberly, Mo.
SWANSTON, WM	Jeffersonville, Madison & Indianapolis,	Indianapolis, Ind.
TWOMBLY, F. M	Old Colony	Boston, Mass.
TWOMBLY, T. B	Chicago, Rock Island & Pacific	Chicago, Ill.
TURREFF, W. F	Cleveland, Columbus, Cin'ti & Ind	Cleveland, Ohio.
TREGELLES, HENRY	New York, Lake Erie & Western	Salamanca, N. Y.
THOMAS, W. H	Chesapeake & Ohio	Huntington, W. Va.
THOMPSON, JOHN		Boston, Mass.
WOODCOCK, W	Central of New Jersey	Elizabethport, N. J.
WIGHTMAN, D. A	Pittsburg Locomotive Works	Pittsburg, Pa.
WHITE, C. W	Louisville & Nashville	Birmingham, Ala.
WHITNEY, H. A	Intercolonial	Moncton, N. B.
DEAN, F. W	Dickson Manufacturing Co	Scranton, Pa.
FORNEY, M. N	73 Broadway,	New York City.
SMITH, WILLARD A	Chicago Review,	Chicago, Ill.
SINCLAIR, ANGUS	National Car Builder, 187 Dearborn St.,	Chicago, Ill.

NEW MEMBERS.

SEDGWICK, EDWIN V	Mexican Central	Silas, Mexico.
RICHARDS, JACKSON	908 Green St.,	Philadelphia, Pa.
DOTTERES, D. H	Atchison, Topeka & Santa Fe	Raton, N. Mexico.
CARSON, M. T	Mobile & Ohio	Whistler, Ala.
GALLOWAY, A	Cleveland & Marietta	Cambridge, O.
STEWART, O	Fitchburg	Charlestown, Mass.
BEAN, JNO	Counotton Valley	Canton, O.
MILLEN, THOMAS	New York City & Northan High Bridge,	New York City.
STINARD, F. A	N. Y. & Green Wood Locks	Pompton Jun. N. Y.

NAME.	ROAD.	ADDRESS.
HOLMAN, W. L	Pittsburg & Erie	Renova, Pa.
HARRISON, W. H	Baltimore & Ohio	Newark, Ohio.
FENWICK	Green Bay, Winona & St. Paul	Fort Howard, Wis.
MILLS, C. W	Rochester & Pittsburg	Rochester, N. Y.
COLLIER M. LAMAR	Western & Atlantic	Atlanta, Ga.
THOMAS, C. J	Chesapeake & Ohio	Huntington, W.Va.
TORRENCE, JOHN	Evansville & Terre Haute	Evansville, Ind.
WHITLOCK, JOSEPH	New Haven & Danbury	New Haven, Conn.
LOCKWOOD, WILL E		251 S. 3d St., Philadelphia, Pa.
ROBERTSON, W. J	Central Vermont	St. Albans, Vt.
MANLY, BASIL	Atlantic & North Carolina	Newberne, N. C.
PITKIN, A. J	Schenectady Locomotive Works	Schenectady, N. Y.
WILLIAMS, R	Toledo & St. Louis	Pine Bluff, Ark.
CROMWELL, A. J	Baltimore & Ohio	Mt. Clair, Md.
BECKET, A	Baltimore & Ohio	Mt. Clair, Md.

The President then delivered his address.

PRESIDENT'S ADDRESS.

GENTLEMEN—It has heretofore been the happy lot of the Chairman to congratulate the Association at its annual meeting, but our sorrow, due to the unhappy event that brings the Vice-President to the Chair—I refer to the unexpected and untimely death of our late President, John H. Flynn—forbids my doing so. I am sure you each, with me, deeply regret the absence of his genial face, kind manner, and enthusiastic interest, not only in our Association but in all matters connected with the progress of mechanical engineering. Before we separate, suitable recognition will, I feel sure, be made by you, both of his worth and of our keen sense of loss. I am grieved to report also, that during the year we lost, by death, three other members, viz.: J. A. Durgin, John Cook, and J. C. Ellis.

My personal thanks, and I think your praises, are due to our energetic Secretary, J. H. Setchel, for the efficient way in which he has carried out the additional duties and responsibilities thrown upon him during the year past. Living as I do, so far north, I have been but of little service to him and he has practically done double duty, and he has done it well. It is the experience of most, if not all engineering societies, that a large measure of the success they achieve is due to the capacity and *vim* of their secretaries.

May ours be spared to us for as long a time in the future as in the —15 years in harness, is it not, Mr. Setchel?

I believe our Association was one of the pioneers on this continent in union for the special purpose of self and mutual education in the practical knowledge of a single branch of engineering, and it is a matter of congratulation that its example should have been so extensively followed in the formation of the numerous other associations and local railway clubs that now cover this broad country. These clubs do not and certainly need not displace our union with is geographically a wider field, and it seems to me they can notably help us. Certainly the members who attend and take an active part in the railway club meetings will make more efficient contributors to, and effective workers in, conventions; better able to get upon their feet and give us lucidly the winnowed results, not only of their practice but of their discussions also. The value of this mutual exchange of experience is now so thoroughly well understood and approved of, that the recollection that but ten or twelve years ago it was necessary to explain and emphasize the fact that our purpose in meeting together was *not* trade-unionism, has to-day almost a comic aspect. But the world grows at many points, and we may yet see the day when presence at convention will be considered a duty rather than the opportunity to attend, somewhat of a privilege conferred.

I am glad to say that our Treasurer's report shows that in money matters we more than make both ends meet, and our general condition and membership is very satisfactory, though it does not leave us without the opportunity for growth and development, both of which I hope we shall achieve this year.

I do not anticipate that any of our subject-committees will report any startling departure from old lines in locomotive design and economy, although definite progress is being made. A consumption of coal per hour per indicated horse-power of nearer 2 than 3 lbs. is a decided mark of advancement, in fact, so excellent a showing as to cause in some minds a doubt as to the accuracy of the experiments proving it. The power developed has been increased without a proportionate increase in dead weight, so that taking only into account the weight of the engine and the boiler, the dead weight per indicated horse power is but from 60 to 100 lbs., an

exceedingly good showing when taken in connection with the small fuel consumption. Also the better proportioning of wearing surfaces, the more efficient lubrication, and the use of purer metals has lengthened the time and mileage between repairs so much, that if we could obtain reliable figures for comparison, the reduced cost of repairs per actual horse-power developed per year would astonish even those who are more or less familiar with the fact that this improvement is going on. And it is this endeavor to secure more power with less metal, with less consumption of coal and water, and with less outlay for repairs, that is the justification of our coming together and exchanging experiences.

There are possibilities for the locomotive in the future, not only in higher boiler pressures, in compounded cylinders and in a valve gear that will give increased freedom from back pressure, but also in the use of exhaust steam injectors, in the use of a forced air supply to the fire under control, as to amount delivered above as well as below the fire-grate, in the use of fluid fuel, in the more perfect lubrication of wearing surfaces so that they shall scarcely be said to wear, and, in the latitude allowed us in construction and design by using metal free from cinder and oxide.

And in the matter of more suitable metals—it is not until we know and can clearly define our wants that we may reasonably expect the manufacturers to meet us and satisfy our needs. This in the past was clearly seen in the quality of steel plate we required for boilers, in the bronzes used for journal bearings, and will yet be seen in this country in suitable steel castings. I have every confidence that our wants, clearly stated, will be soon satisfactorily met and eventually cheaply met.

So much attention is now directed towards improving locomotion, and so many experiments are being made upon Tramways and Suburban Railways with such varied sources of motion as electricity, compressed air of both high and low pressure, hot water, and endless rope, in addition to centre-grip rail, rack-rail and single rail engines, that I would suggest to the Committee on Subjects, the advisability of their considering some of these varieties, if only to make comparison with ordinary locomotives, believing that such a course would not only prove of interest but would probably enlarge our membership and widen the scope of our discussions.

The same may be said of the electric lighting of engines and trains and electric signalling, the knowledge of which must soon *per force* become part of our stock in trade.

The apprentices and young men of this age and country are to be congratulated on their opportunities for obtaining exact knowledge. The elaborate systems of technical training, both in shop and drawing office, now adopted by the mechanical departments of our railroads, and in some cases by the large factories, will assuredly develop the capable men and capable minds, and we need them all, in fact, cannot have too much trained common sense brought to bear on the multiplicity of details that crowd upon us for attention and settlement daily and hourly, and it is only in securing and utilizing well trained help that we can reasonably hope to handle our business with the thoroughness now demanded.

This magnificent city of Washington, so steadily growing in beauty, will no doubt take up part of your time, but I hope not too much. Its very name is an insiparation to directness of speech and the place itself should be, to wide inclusiveness of thought.

As a Canadian it seems to me not out of place to congratulate Americans on a President, who, to the eyes of outside observers, seems to have so much at heart the good of the whole American nation, administering his government with the foresighted wisdom of a statesman and the common sense that marks a successful business man. Our training leads us to admire his and, in fact, any application of simple and direct means to the attainment of clearly seen definite ends.

In conclusion, may I, as a personal favor, bespeak your cordial assistance and practical sympathy in conducting the business of our meetings so that any defect or inexperience on my part may not detract from a full measure of success and satisfaction in this, our 18th Convention.

Gentlemen, the meeting is now open for regular course of business.

THE PRESIDENT—The Convention is now open for business.

N. E. CHAPMAN—I desire to call the attention of the members of the Association to the remarks of our presiding officer upon the death of our President, who was elected last year at our meeting at Long Branch. Mr. Flynn joined this Association some fourteen or fifteen years ago and I do not think he has ever missed attendance upon our meetings. He

has been active in everything connected with the advance and interests of this Association. His pleasant countenance, his cordial grasp of the hand, will be missed by all, especially by me, having known him since his first connection with this body. He was a man very well thought of at his home in Atlanta, being first and foremost in everything pertaining to the social and business advancement of that city. It seems to me a fitting time, if it is now in order, for the President to appoint a committee to draw up suitable resolutions, expressing the sense of the convention in regard to our loss. I would, therefore, move that the President appoint a committee of three to prepare suitable resolutions.

MR. BRIGGS—I second the motion.

The motion was carried.

THE PRESIDENT—I will appoint as such Committee Ex-Presidents N. E. Chapman and J. N. Lauder, and associate member Mr. Angus Sinclair. I think it would be proper, under the circumstances, to take a recess so that in the interim the Committee can draft the resolutions. I therefore declare a recess of thirty minutes and the Convention will come to order again at 11 o'clock.

RECESS.

Upon the re-assembling of the Convention, the Committee on Resolutions, through Mr. Sinclair, reported as follows:

WHEREAS, in following his inscrutable decrees, the Almighty, since we last met, has removed by death our highly esteemed President, John H. Flynn, it is therefore

Resolved, that we, the American Railway Master Mechanics' Association, desire to record our sense of the irreparable loss we have sustained;

Resolved, that we express our condolence with the family and friends of our deceased President, in the severe bereavement they have sustained, and that a committee be appointed to prepare a biographical account of the life of our late President, to be incorporated in the records of this Association;

Resolved, that a copy of these resolutions be transmitted to the family of the deceased member.

On motion of Mr. Setchel, seconded by Mr. Swanston, the report was received and placed on file.

MR. BRIGGS—I hardly feel able to render to the memory of my friend, John H. Flynn, such reverence as I feel is due him, but I cannot let the occasion pass without saying a few words. It was my pleasure to have enjoyed his acquaintance and friendship since 1833, knowing him intimately, and our relations as journeymen machinists, locomotive engineers, and master mechanics, have always been of the most cordial nature. When I needed a friend to consult, I called upon John H.

Flynn, of the Western and Atlantic Railroad, and he never failed me, Oftentimes I felt I was running a great risk in following his advice, but, in spite of my own thoughts, I did as he directed me and came out victorious. I believe if there ever was a man in America who honored the position of master mechanic of a railroad, it was John H. Flynn. He was a man of the highest integrity, and when I say that he held his position through the various forms of administration that pertained to the Atlantic and Western Railroad when it was run by the State of Georgia, you will recognize the fact that he must have been a man of remarkable ability, both as a citizen and a mechanic, to have given, as he did, perfect satisfaction. I can only say that the resolutions you have passed re-iterate my own sentiments, and I am sorry that words are not at my command to express the feelings of my heart in his memory.

MR. SPRAGUE—I presume I can say, without disparagement to our presiding officer, that it is a matter of regret to us all that John H. Flynn is not presiding over our deliberations to-day. Although the South is not represented largely in this body, yet we all of us felt that it was well represented when Mr. Flynn was with us. So far as making remarks here eulogistic of him are concerned, it is useless. We all know his memory and his work. I only wish to add my tribute to the universal feeling that we have lost a man whose place will not soon be filled in this Association.

MR. LAUDER—In rising to cast in my mite in eulogy of our friend and late associate, John H. Flynn, my voice trembles. When I think of him as he was one year ago, when he got up to acknowledge his appreciation of the compliment we had paid him, by electing him to preside over us at this meeting, I well remember that the tears started to his eyes. I am free to say here now that I have that same feeling—the tears almost start to my eyes. This Association is placed to-day in a position that it never occupied before. We have lost our active presiding officer, a man who was elected to that honorable position, but who did not live to preside over our annual gathering—something which never occurred before in the eighteen years of our existence. Fortunately, we have men as vice-presidents who are amply able to preside. But we have not John H. Flynn. A noble man! A splendid presiding officer! A man who could always get up and express his thoughts in an easy educated manner, something that few of us, perhaps, are able to do. I simply want to cast in my tribute towards the eulogy that has already been expressed to the memory of him, who one year ago was elected President of this Association.

MR. WOODCOCK—Mr. President: When I received a telegram announcing the death of our friend, Mr. Flynn, I could hardly realize it and

can hardly do so to-day. At our last Convention we were together considerably, and at every Convention since I first met him, I have had a higher opinion of his character and worth, and was ever willing to sit at his feet and receive counsel. I feel that this Association has lost one who had the deepest interest in its welfare. Of course we all have an interest in the Association, but he seemed to be very earnestly interested, and his genial countenance always gave us inspiration. He is not here. He has fulfilled his part in life. John H. Flynn is dead. It is needless for us to speak of his character or work. As has well been said, actions speak louder than words, and we leave his character to testify of his great work.

THE PRESIDENT—If there are no further remarks on this subject, we will proceed with our regular order of business. The first in order will be the reading of the combined report of the Secretary and Treasurer.

To the American Railway Master Mechanics' Association:

GENTLEMEN—I herewith submit for your information a detailed statement of the condition of membership, finances, and such other matters as have seemed to come within my duties as Secretary, and that are of sufficient importance to justify a brief mention.

On account of our Treasurer, Mr. Richards, being out of the country I have, at the request of the President made this a joint report, giving full detail of receipts, expenditures and money now on hand, to all of which your careful attention is invited.

MEMBERSHIP.

Since last report 17 members have joined the Association: six have resigned and twelve have been dropped from the rolls on account of being delinquent in dues.

John H. Flynn, our worthy President, James Cook, of the Danforth & Cook's Locomotive Works, John C. Ellis, of the Schenectady Locomotive Works, and J. A. Durgin, late of the Rhode Island Locomotive Works, have passed away to join the company of Hayes, Fry, Hudson and others of our number, who have gone before. With these changes and these losses our present membership is as follows:

Regular members	220
Associate "	13
Honorary "	3
Total	236

PRINTING.

The following propositions from the Aldine Printing Works, of Cincinnati, after due consideration, was accepted as the lowest and best bid for printing the annual report:

J. H. SETCHEL, Secy.

Dear Sir:—I will print and bind you 1200 *copies of the American Railway Master Mechanics' Association reports in the same style, using the same paper, same amount of matter and number of insets as last year, for the same price named,* $594.76, *with a proportionate reduction or increase for a greater or less number of pages or insets.*

I guarantee to do the work in the best manner and without unnecessary delay when favored with the order.

Yours truly,

CINCINNATI, Sept. 9th, 1884. *C. J. KREHBIEL.*

Under this contract 1200 copies were printed and a copy sent to each member with an invitation to the Road represented to subscribe to our printing fund. To this 48 have responded and a few others have promised, but have not yet made the remittances. In only two cases has the contribution been refused, and this, your Secretary thinks, under the depressed state of business existing throughout the country, is a very favorable showing for the interest taken in the Association. To each of these corporations there has been sent not less than six and as high as fifty copies, this last number, however, having been sent to the Rogers Locomotive Works only, for an annual contribution of fifty dollars.

In this way 708 copies have been distributed to members and corporations. The following is a list of the donors and the amounts contributed.

W. W. Evans	$ 5.00
Atchison, Topeka & Santa Fe R. R.	10.00
Rogers Locomotive Works	50.00
W. W. Evans	10.00
Rhode Island Locomotive Works	10.00
Midvale Steel Works	25.00
Niles Tool Works	20.00
Baldwin Locomotive Works	20.00
Boston & Providence Railroad	10.00
Chicago & Eastern Illinois Railway	10.00

Brooks Locomotive Works	$25.00
Nathan Manufacturing Company	25.00
Raleigh & Gaston Railway	10.00
Pittsburg Locomotive Works	10.00
Machine Tool Works	10.00
New York, Lake Erie & Western	10.00
Boston & Albany Railway	10.00
Des Moines & Fort Dodge Railway	10.00
H. K. Porter & Company	10.00
Missouri Pacific Railway	10.00
Illinois Central "	10.00
Lake Shore & Michigan Southern Railway	10.00
Chesapeake & Ohio & South-Western Railway	10.00
Chicago, St. Paul, Minneapolis & Omaha "	10.00
Chesapeake & Ohio Railway	10.00
Portland Locomotive Works	10.00
Louisville & Nashville Railway	10.00
Cleveland, Columbus, Cincinnati & Indianapolis Railway	10.00
Capiopa Railway	10.00
Providence & Worcester Railway	12.00
Delaware, Lackawanna & Western Railway	10.00
L. B. Flanders' Machine Co.	10.00
Terre Haute & Indianapolis	10.00
Connecticut River R. R.	10.00
Chicago, Rock Island & Pacific	10.00
Roanoke Machine Works	10.50
Lehigh Valley	10.00
National Tube Works	10.00
Hancock Inspirator Co.	10.00
Schenectady Locomotive Works	10.00
Taunton Locomotive Works	10.00
Grand Trunk Ry.	10.00
Grand Rapids & Indianapolis Ry.	10.00
New York, Susquehanna & Western	10.00
Old Colony R. R.	10. 0
Ohio & Mississippi R. R.	10.00
Houston & Texas Cent.	10.00
Kansas City, Ft. Scott & Gulf	10.00
J. P. Horniblow	10.35
Fitchburg R. R.	10.00
Total	$602.85

The following is a statement of money received from all sources:

Assessments	$1,110.00
Initiation	17.00
Printing Fund	602.85
Sale of Reports	81.75
	$1,811.60
Balance in Treasury at last report	367.96
Making total amount to be accounted for	2,179.56

EXPENDITURES.

Voucher No. 1	J. H. Setchel, salary as Secretary,	$800.00
" " 2	Bill for Desk	12.00
" " 3	Aldine Printing Works	16.00
" " 4	Railroad Gazette for Engraving	450.81
" " 5	Aldine Printing Works	496.29
" " 6	Cincinnati Safe Deposit Co.	10.00
" " 6	Aldine Pʻinting Works	10.00
" " 8	J. H. Setchel, for Postage	76.20
		$1,871.30
Balance		308.26
Total amount accounted for		2179.56

These vouchers have been examined by the Supervisory Committee and approved by the President.

BOSTON FUND.

This fund consisting of	$4,800.00
Interest uninvested at last report	400.93
" July, 1884	48.00
" Oct. "	48.00
" Jan'y, 1885	48.00
" Apr. "	48.00
Represents a total value of	$5,392.93

By this amount it will be seen that the uninvested interest at May 1st, was $592.93, which by order of the Supervising Committee has been invested in four One hundred dollar U. S. Bonds, for which we paid $494.00, leaving a remainder of $98.93 uninvested interest. The foregoing statement with vouchers, papers and moneys, are respectfully submitted for your examination and approval.

[Signed.] J. H. SETCHEL,
Secretary and Acting Treasurer Trustees Boston Fund.

On motion of Mr. Sprague, seconded by Mr. Briggs, the report was received.

THE PRESIDENT—As customary, I will appoint an Auditing Committee, consisting of N. E. Chapman, James M. Boon, and W. F. Turreff. I will appoint as a Committee to decide upon the assessment for the ensuing year William Smith, Charles Graham, and John Campbell.

The Secretary informs me that he has a special report to present; and if there are no objections, it will be read at this time.

To the American Railway Master Mechanics' Association:

GENTLEMEN:—At the 17th Annual Meeting Mr. J. N. Lauder offered the following resolution, which, upon motion, was adopted:

Resolved, That the standards adopted up to the present time by the Master Mechanics' Association be printed in our annual report.

The Master Mechanics' Association as a body have not been as prolific in adopting standards as some of our kindred societies; and the number to report will not be as great as its age might indicate.

We believe that the opinion is held by the majority of the members that much more good is accomplished by an intelligent discussion of questions by the many than the passage of a resolution emanating from the brain of a single individual, which are often adopted against the will of a silent majority. Many seemingly knotty questions have been made clear by the discussions had at the conventions, and a member has been able to go home and take a step in advance of any standard that could be adopted at the time.

Many things that seem difficult to decide are only so because the subject is not fully understood.

Discussion brings out the dark points so that we are able to advance, and to adopt a certain rule as a standard often means to stop advancing.

There are, however, many parts of the machinery in the construction of railway plants where uniformity can and should be secured by the adoption of standards, and to these I think it will be found the Master Mechanics' Association has given due attention. In the third annual report the convention on standard nuts recommended the adoption of the United States standard, but in receiving the report the Association did not adopt the Committee's recommendation, as it was no doubt the intention to do, and Mr. Chapman, who was Chairman, so stated at the fifth annual meeting. At this

meeting, on motion of Mr. Hayes, the same Committee was appointed to confer with the bolt and nut manufacturers, and at the sixth annual meeting made the following report:

"Your Committee appointed at the first annual meeting to confer with a Committee appointed by the Association of Bolt and Nut Manufacturers of the United States, upon the subject of uniform standard sizes of nuts would recommend the adoption of the sizes of nuts as adopted by the Manufacturers' Association at their meeting, December 11, 1872."

STANDARD WHEEL CENTRES AND TIRES.

At the third annual meeting this subject was brought up and excited a large amount of discussion, resulting in the appointment of a Committee to report the next year, but at the fourth annual meeting the President announced that there would be no report from this Committee, and the subject has never since been taken up.

SWITCHING ENGINE MILEAGE.

At the fifth annual Convention a Committee previously appointed on the subject of computing mileage of switching engines, reported in favor of allowing six miles per hour for switching engines, and six per cent. to train mileage of local freight for switching, and no extra mileage for through freight and passenger trains, which was adopted.

STANDARD AXLES.

At the seventh annual meeting a Committee on the subject of standard axles recommended the adoption of an axle for tenders as follows:

Length over all, 6 feet 11¼ inches, journal 3¾ x 7 inches, wheel seat 4⅞ inches diameter by 8 inches long, diameter in center 4 inches, collars 4¾ inches by ⅝ of an inch thick. After considerable discussion action was postponed and the subject was referred back to the Committee. At the eighth annual meeting the Committee on Standard Axles offered the following resolution:

Resolved, That this Association concurs with the Master Car Builders' Association, recommending the adoption of the standard for car and tender axles which that Association has proposed, when said axles are made of iron. After considerable discussion the resolution was rejected, and was not again brought up until the

twelfth annual meeting, when, on motion of Mr. Johann, the Master Car Builders' standard was adopted.

STANDARD JOURNAL BEARING, JOURNAL BOX AND PEDESTAL.

At the fourteenth annual Convention the following resolution was presented and adopted:

Resolved, That the drawings of the car journal bearing, journal box and pedestal, of which copies are submitted herewith, be declared to represent the standard form and proportion for these parts, and that the same be recommended by this Association for general use on engines and cars.

STANDARD SHEET METAL GAUGE.

At the fifteenth meeting of the Association, Brown & Sharp's Micrometer Gauge was adopted as the standard.

STANDARD LIMIT GAUGE.

At the seventeenth annual Convention the Prat & Whitney Standard Limit Gauge for round iron was recommended and adopted.

To recapitulate, the following are the standards adopted by the Association :

Nuts—United States Standard.

Screw Thread—United States Standard.

Switching Engine Mileage—Switching engines six miles per hour ; local freight engines six per cent. added to train mileage.

Standard Axles, Bearings and Boxes—Car Builders' Standard.

Standard Sheet Metal Gauge—Brown & Sharp's.

Standard Limit Gauge for Round Iron—Prat & Whitney's.

Very respectfully,

J. H. SETCHEL, Sec'y.

On motion of Mr. Sprague, seconded by Mr. Lewis, the report was accepted.

THE PRESIDENT—The next order of business is the report of the Committee on Boiler Construction. It is in the hands of the Secretary. The Secretary reminds me, however, that it is our hour to devote to the discussion of special questions suggested by members, and it would be perhaps well to postpone the reading of this report until later.

MR. SETCHEL—The following question has been handed in : What is the proper height to turn flanges on drivers and truck tire ? The question is proposed by Mr. H. N. Sprague.

MR. SPRAGUE—I was lead to this question by the fact that I have to turn down the flanges of all my tires. They are rolled higher than I use them. I wanted to get at a standard if I could, as to how high they should be made. I am under the impression that nobody uses a 1¼ flange, and I think we should tell the tire maker to make them lower in the first place, instead of compelling us to turn them down afterwards. I would like to hear from the members of the Convention, if any of them approve of flanges as high as that. If not I don't see why they should be made so high. I don't see why we should expend time and waste material in turning them down when they could as well be made lower in the first place.

MR. MCCRUM—I think as Mr. Sprague does, that there is no need of so much height of flange.

MR. SPRAGUE—The Master Car Builders have adopted 1⅛ as the extreme height of flange. Certainly that is sufficient. I would like to know if anybody uses a flange higher than 1⅛ inch.

MR. BLACK—For the last two years we have been using them one inch, and we ordered them to be rolled that size and think there is quite a saving in it.

MR. HATSWELL—We use a flange of 1 1/16 inch, and we have never had any trouble with any of our engines running off the track, because of the low height of the flange.

MR. LAUDER—I think that this is a question that is really worthy of our consideration. If a large number of our members are in the habit of starting out with their tires an inch high and some even less and some with the tires rolled 1¼ inches high, there is manifestly a leak that we ought to stop, not only in the extra amount of metal that we have to pay for, but in the time and labor occupied—which means money—to reduce that flange from 1¼ inches to one inch. My own feeling is that an inch high flange is enough. I don't think any higher flange would give us any more safety. Therefore, if an inch is enough, why make it higher? I think it will be necessary to start out with such a flange as we want, so that there will be nothing to do but with the face of the tire. I am glad my friend, Mr. Sprague, brought this up, because I think it is something that should be agitated. We should adopt something that we can say to the manufacturers is the standard height of flange. They would not be willing to adopt anything that we should suggest, of course, if we were not unanimous. Possibly it would be well to have a committee appointed, to get at the opinions of the railway men of the country with a view in the future of adopting a standard height of flange, and also a standard shape. I do not know that a committee will be necessary, but I do think that something ought to be done towards getting a

uniform height of flange in order to relieve ourselves of some expense as well as to relieve the manufacturers of some embarrassment as to what they should make.

MR. SPRAGUE—I asked a manufacturer if he could not roll a flange 1⅛ as well as 1¼ inches, and he notified me that they could, but at the same time it would involve a little extra expense. And I see the point why it would be at some extra expense, because they want their rolls uniform; and if we could agree upon a height, so they could make their rolls uniform and be without extra expense in turning them down for a special order, it would be of immense advantage, not only to us, but to the manufacturers.

MR. JOHANN—It is my practice to use on our road one inch and it is my opinion that is sufficient height. Anything higher than that is superfluous and wasteful. In fact, I think with the improvement in rolling tire, that we ought to get them rolled to uniform caliper, so that there will be really no necessity for turning them at all. I have not turned a new tire where I have the full set of uniform caliper for some years, and I have had just as good results as when I did turn them. In order to enable the tire manufacturer to make his tire uniform on the outside, I have been buying my tire bored to the gauge, by doing which, there is no reason why the outside should not be set to bore of uniform thickness, and leave the inside to bore out, and then have a uniform tire all through. I think the question of height of flange is very pertinent and should receive attention from the members of the Association, and I think we should come to some determination so as to enable the tire roller to get his rolls in such a shape that he can make the flanges uniform; that he will not have to make one tire one inch for one road, and 1¼ inch for another road, and so on. One inch is sufficient, with a well-defined and well-proportioned flange, and even then you have more than you need.

MR. LAUDER—The remarks of Mr. Johann brought something else to my mind. I think the Committee on Subjects should recommend as one subject for the coming year a uniform size of driving-wheel centers. That question was up some sixteen years ago, and, until I listened to the report of the Secretary, I had supposed that this Association had adopted at one time a uniform size of locomotive driving-wheel centers. I was surprised to find that no definite action was ever taken in that direction. It is something that we should have decided years ago. When you come to consider the vast variety of sizes that we have, it makes it utterly impossible for manufacturers to roll up and keep a stock of tires on hand. If we had a uniform size—absolutely uniform—a manufacturer in dull times could roll up any amount of standard tires, knowing that they would be used and he could supply his customers at a mo-

ment's warning, and feel safe that his tires would never be thrown back upon him as dead stock. I think a committee should be appointed on wheel centers, and it would be perfectly proper for them to have that question of height of flanges assigned to them also, and they could make a report on the whole thing. The opinions of men vary, and, while I may think that an inch is enough, others might think it required a quarter of an inch more. Therefore, I think a committee should take this matter up, and make an exhaustive examination of the whole question and present a report at our next annual meeting that we can probably adopt.

MR. JOHANN—I fully concur in what Mr. Lauder says, and I think that is really a very important subject, not only to the Association but to the tire manufacturers, and it is a question that ought to be settled by the Association. I think it is neglectful to have allowed it to have gone thus far. Every locomotive manufacturer has his own peculiar sizes for his driving-wheel centers, and unless he gets special plans and drawings he will make them according to his own patterns. Now, there is no reason why locomotive centers and tires should not all be of uniform diameter, and I think if this matter is taken in hand the committee will find that they will have a very prolific subject to work upon. They should not only determine the uniform diameters of centers, but the uniform thickness of the tire. In fact, they should settle the whole wheel and tire question, so everyone will know what it is, and then we should proceed and execute it. To a certain extent, I have been practicing uniform diameters in my own way on the road that I represent. There is no reason why it should not be uniform all over, and our members certainly should understand, that, when this committee do work this question up, they then should take hold of it and commence and work it themselves, and not simply because their own individual views are not entirely met with therein, that they will still go on in their old grooves. We must give and take between each other, and whatever is adopted we must take hold of it and put it through. If you have any locomotives that you cannot bring to this particular dimension, let them go; they will soon wear themselves out and be sent to the bone-yard and burried, but in anything you make new, make it to the adopted standard. Therefore, I hope there will be such a committee appointed.

MR. BLACK—This subject is one of importance. I do not see any good reason why this Convention could not settle it to-day.

MR. JOHANN—Oh, no; it would take two years to settle it.

MR. BLACK—Well, I don't see any good reason why it should.

MR. LAUDER—I hardly think we could do what Mr. Black suggests. There would be such a conflict of opinions. Every large road has prob-

ably got their particular standard, and they will try to bring every fellow to them. I know I should. It would be simply talk, talk, talk. Matters of this kind must be brought before the Convention in the form of a report from a committee. That committee can get the views of all the railroad men and locomotive builders, and boil it all down. It would take all our sessions here to decide that one point. A committee is the best way. That will bring us much nearer to a uniform standard than anything else.

MR. SPRAGUE—I move that the President appoint a committee on uniformity of driving wheel centers and height and shape of flanges.

MR. BRIGGS—I second that motion.

MR. JOHANN—Put in uniformity of thickness of tires.

MR. SPRAGUE—No, I do not think it is best to put that in.

MR. SHAVER—I think the motion should also include a standard section of tire.

MR. JOHANN—I think this noon hour is simply for the purpose of desultory talk, and not for the purpose of raising points of order on motions. Now, I think it is practical to have a uniform thickness of tires. A committee can embody a uniform thickness of tires; that is, if you determine upon that, a railroad company won't have to carry any large stock, because the tire manufacturers will manufacture these tires just the same as the wooden ware manufacturers manufacture a set of buckets. As it has been heretofore, every one having their own particular sizes, the tire manufacturer could not manufacture any stock to keep on hand. It was not profitable for him to do so. But if you come to some determination, the larger part of the railroads will adopt a uniform standard. There might be some question about some certain peculiar work, for which you would not want that kind of a tire; but with this vast system of railroads that we have now, and the almost practical uniformi y in the character of locomotives, I see no impediment in the way of having that matter entirely settled as to diameter of centers, thickness of tire, height and shape of flange. Now, as Mr. Black has remarked, that he thought this matter could be settled to-day, I want to say that if it is settled in two years it will be doing exceedingly well. The proper way to go about this thing is: first, this committee will want to get information from all sources, from the master mechanics, as to what they are using, and what in their opinion is the best to use; also to get all the information and views they can from the tire manufacturers; then get down on paper, both in scrip and drawings, that information thus obtained, and present it here for the information of the members and for discussion next year. Then the year following we shall probably be able to come to some decision about it. That is the only proper way to do.

MR. BRIGGS—I believe a question is before the house, and I think this discussion is out of order.

MR. SPRAGUE—I was going to remark that if the man who seconded my motion would consent, I would add to it the uniformity of tires.

MR. BRIGGS—I seconded the motion, but I do not favor the uniformity of tires.

THE PRESIDENT—Then the motion will stand as originally made.

MR. HATSWELL—Is not the standard thickness of tires included?

THE PRESIDENT—If you wish to include that, an amendment is in order.

MR. HATSWELL—I offer an amendment that the standard thickness of tires be included.

MR. SWANSON—I second that motion. In seconding it I desire to say that I believe the thickness of the tire is a point of economy, and we want this committee to give us the proper thickness in order that we may obtain the greatest economy.

MR. SPRAGUE—One reason why I did not include the thickness of the tire was, that the various kinds of service require different thicknesses. I have some small engines in a furnace yard adjacent to our works that I do the repairs on, and standard tire with them is 2½ inches. They wear those tires so badly that they do not pay for turning. I advised putting on a three-inch tire. My idea was to get what service we could for our engines. The thickness of tire does not govern or control our standards.

MR. LAUDER—I am in favor of the amendment for this reason. It is an open question with some of us—with me, at least—whether you get as uniform a metal in a large mass of steel as you would get in a small one. In other words, whether you get as uniform steel in a four inch tire as you would in a three inch. I would like to know that, if it can be ascertained by this committee. They can confer with the manufacturers and be prepared to give us some idea about it. I am in favor of the amendment, because I believe the committee can take that matter up and present us with a valuable report on the subject.

MR. JOHANN—I do not think that we want to have too many points of order during this noon hour. I haven't any particular feeling about the matter, and it is immaterial so far as I am concerned individually. Mr. Sprague argues his point from a manufacturing standpoint. I am arguing it from a railroad repair standpoint. I do not see any impropriety in leaving this question with the committee to let them bring all the facts before the Association. Then if the Association sees fit to adopt it they can do so, or if they see fit to reject it they can do that. I believe it is in the line of economy to adopt a uniform standard, not alone of height, but also of thickness. My own opinion is that a large proportion of the

railroads will accommodate themselves to the standard thickness, and every one is still at liberty to order any special thickness they want. This is simply a question of convenience. If you have a uniform tire for the different diameters of your centers, your tire maker can make tires and keep it in his yard, and when you want any you can telegraph him and he can ship it to you. Your tire maker cannot make every size and keep it in stock, consequently now when you want tire you have to wait until they are made.

MR. BLACKWELL—I think the committee should decide upon the standard shape as well as depth of flange, and ought to report also as to the thickness and the shape of the tread. Now, a manufacturer may be requested to make a tire three inches thick. How is he to tell from what point he is to make that measurement? Is that tread to be made narrower just at the edge of the tread, or is it to be tapered the whole width?

MR. COOK—I would inquire if they do not have to turn off from their driving wheel centers sometimes to get good surface for their tires.

MR. LAUDER—I can answer for one that we do not, if we use a good steel tire, unless the tire gets loose. I do not think I have ever had a center injured.

MR. SETCHEL—This is about the scene that took place 13 years ago when this same subject was up. Everybody was so interested then, so anxious to have a committee appointed, that it was a matter of great surprise to me at the next meeting when the President announced that there would be no report from that committee. Many of the same members figured in the discussion then that participate in it now. My friend Lauder among others.

MR. LAUDER—I am not certain that I was on that committee.

MR. SETCHEL—My impression is that Mr. Lauder was chairman of the committee. Now there is a great deal of meat in this subject. It is important that we should be able to get tires upon a moment's notice, and it is impossible to do that if we are obliged to manufacture a tire of an extra size. And I think it would be nothing more than fair if members will not come to a standard, to have the manufacturers make out their bills the same as hotel proprietors do; when anything is ordered that is not on the bill, charge extra for it. There is a nominal size for a 5½ foot wheel that can be fixed upon, and I think very readily adopted by a majority of the roads if that size were only known. I know that in turning down your wheel centers I have very often thought that if I only knew what the size was in general use I would make these wheel centers that size, but not knowing, of course, I turned it to the most convenient size. It seems to me that if that committee will go to work and get the average for a 5, 5½, and perhaps 6-foot wheel—although there are very

few of the latter class running—that we will be able to help the manufacturers, and in that way help ourselves in obtaining the fulfillment of our orders readily, and avoid carrying a large amount of money in steel tires. In regard to the thickness of tire, I think that committee should include that in its work, though I believe, as a general thing, the three inch tire is adopted throughout the country. It is very clear to me that by using a thick tire we save a considerable amount of metal. We can only run the tires down to one inch or 1½, and if you have three inches, you wear away two inches; and if you run a two inch tire you have as much to throw away as you have of wear. Aside from the question raised by Mr. Lauder, whether you can get as good sound quality in a thick tire, I would say that the thicker we run our tires the better. In regard to the width: we very often see, in traveling through the country, engines with tires extending beyond the wheel center from one fourth to five-eighths and three-quarters of an inch. In some cases that may be necessary to provide for narrowing the gauge. But as a rule, anything beyond three-sixteenths to five-sixteenths of the wheel center is of no use. It is a positive hindrance in the wear of the engine, because it always leaves a rim on the outer edge, and you get a flange on both sides of your tire before, perhaps, it is worn so that it ought to be turned, and the less you can have extending beyond what is actually necessary, for the tread of the wheel is not only a loss on account of being extra weight, but is a positive detriment to the track, to the wheel, and to the running of the engine.

MR. LAUDER—I always have a great deal of trepidation when our friend Setchel gets up, because he invariably pitches into somebody, and generally into me. If there is a loop-hole on my part he knows it, and he does not hesitate to pitch into me. Now, if my recollection serves me right I was not on that committee. If I had been, probably you would have had a report. I was on a committee on the best kind of steel tires, and I must say, that I did more work on that committee than I ever did on any, but I was not chairman of it. The chairman of it was, and is now, the master mechanic of the Cheshire Railroad. He made a good report. The Committee on Standard Diameters of Wheel Centers, I am very sure, I had never anything to do with. Therefore, I want to wash my hands of the stigma that has been placed upon me by our worthy Secretary. Now, I hope this whole matter will be referred to a committee who will take it in charge, not being confined to what we may specify, but the standard wheel center, the thickness of the tire, the shape and height of the flange, the tread of the wheel, the width, in fact, consider the whole business. They might just as well get the whole information about everything as to get a part of it. If the proper

committee is appointed I hope nobody will interpose obstructions towards having it go into the whole matter, and report anything that they may see fit.

A vote was then taken upon the amendment, and it was carried.

The question then being upon the original motion, it was carried.

MR. SWANSTON—I understand that several of the members have gone back to iron for side sheets and fire boxes instead of steel. I would like to hear from any one who has done that and I would like to know what their experience has been that has induced them to do so.

MR. STEVENS—I think Mr. Bushnell is in the room and can give you some information on that point, because I understand he has adopted iron.

MR. BUSHNELL—Whoever said that I had adopted iron is mistaken about that. I have only put in two boxes.

MR. SETCHEL—If Mr. Swanston will allow me I would like to make a suggestion right here. This question comes up in the Boiler Committee's Report, and I suggest that discussion upon it be delayed until that report is presen ed.

MR. SETCHEL—The following question has been handed me: What is the best method of increasing the traction of locomotives? The question is presented by Mr. Briggs.

MR. BRIGGS—For increasing the traction of eight-wheel American style of engines, I see there are devices being used by different roads, and, being desirous of using something of that kind, I would like to get some information.

MR. SHAVER—It would be well to include that in the standard wheel gauge committee work, provided for in the motion of Mr. Sprague, which was carried. I think it would be well to have that reported upon.

MR. SETCHEL—Under the head of Mr. Briggs' question, I would not undertake to say what is the best method, but I may say that for the last six months we have employed the best method we know of on the Ohio & Mississippi Railroad, on a passenger engine, 18x24, running a very heavy night train, and a 10-wheel 19x24 freight engine. It is a device simply for throwing the weight of the tank at will upon the drivers of the engine by a piston attached where usually the bracket of the cab is, on the right hand side, which lifts on a projection from under the tank, and by that means you are enabled to put from three to five thousand pounds weight upon each driving wheel of the engine, from the tank. Very often you are running along with just all that the engine can pull when occasionally the driving wheel imperceptibly slips on the track, and in such cases you can throw on that traction increaser and that all stops at once. It is hard on the springs, but it answers almost entirely

in the place of sand. The only danger that I see in the use of it—and that really is easily overcome if you give the engineer orders not to use it at such times—is on a bridge or trestle work, where, if this weight was suddenly thrown on, great damage might be done. But when applied judiciously I think more work can be got out of an engine by it than by the use of sand, and at a very much less expense. The device that I speak of, I believe, is patented by a man by the name of Dees, of Moss Point, Mississippi. I must say that our experience with it has been very satisfactory, indeed.

MR. WHITNEY—Is there no danger to the rail? We generally hold our engines down now with all the weight they can bear, and if we throw any more weight on them I think it would increase the danger.

MR. SETCHEL—This weight is not thrown on suddenly. It can be put on just as gradually as you wish. There is no shock. You simply transfer to the drivers the additional weight. So far as the hammering of the rails is concerned, you do get that much heavier blows, of course.

MR. BRIGGS—This device is only intended to be used in starting, as I understand. We are all aware that the difficulty in starting necessitates the use of sand, and if this device will prevent that, naturally, I think it must be a benefit.

Mr. SETCHEL—I believe the wear of the tire is much less when there is no slip than it is when there is an imperceptible slip going on all the time.

MR. LAUDER—There is another point that occurs to me, which is that the sanding of the rail makes a train draw harder, especially on curves. I have been connected with roads where we had to sand the rail for miles in order to pull freight trains around curves and up grades. Possibly this traction increaser might make a difference in that direction, if it will do away with the necessity of using sand. In starting from a station the difficulty encountered in pulling the train over sand perhaps does not enter into it so much as it would on a heavy grade. I should presume this device might be of value.

MR. BRIGGS—I understand that Mr. Fuller, of the New York, Lake Erie & Western, has had some experience with these devices, and I would like to hear from him.

THE PRESIDENT—Mr. Fuller does not seem to be present.

Mr. SWANSTON—We put one of those devices on an 18x22 engine. We tried it on a grade of about sixty foot to the mile. We started out without the use of a traction increaser or sand, and we took up eighteen cars, and then came back and took another car on, and then stated again, and we slipped and stopped. Then we went up with twenty-four cars with the traction increaser, but still we slipped, and we went back and dropped off one. Then we tried it again, and we slipped again, and then we went

back and dropped another. Finally, after making several trials, we went up the grade with twenty-three cars. We did not consider the device was of very much value, and we never got any more of them.

MR. SINCLAIR—I have been familiar with a good many experiments that have been tried with traction increasers in the past, and also quite recently. They seem to come up periodically and gain favor, and then drop into disrepute very suddenly. It has been the same since the railroad era, when the necessity for putting greater weight upon locomotive drivers has periodically arisen, when attempts have been made to increase the traction by means of traction increasers; but they have never held their own for any length of time. A device of that sort had considerable application in America during the first ten years of American railroad operation, and had perhaps as thorough a trial then as it is ever likely to have again. Recently I learned some particulars of a test made on the Burlington, Cedar Rapids & Northern Railroad, both with and without a traction increaser. The President of the road wrote me that they were going to use the traction increaser there, and I paid considerable attention to their experiments. They put it on one of their eight-wheel engines, expecting that it would help them do more work. They went out with a train to a heavy grade near Cedar Rapids, and started as many cars as they could with the traction increaser. They stuck on the hill and had to go back and drop off some, and finally they went over with eighteen cars. They repeated the same operation without the traction increaser, and they went over with just as many cars. That is one of the most recent experiments that has been made in that direction.

MR. BRIGGS—I cannot see how it is possible that an engine can do as good work with from 3,000 to 5,000 less pounds on her drivers than she can with that weight there. Evidently if this device can be applied instantly, it must be a benefit to the engine. The point I want to make is this: What are these machines? Have they been practically tested, and if so, what has been the result? They must be beneficial. We are trying to accumulate weight on our drivers and engines in one way and another all the time.

MR. LAUDER—In reply, I will say that we have just had an accoun of an experiment going to show they were of no earthly use.

MR. SETCHEL—That does not answer Mr. Briggs question.

MR. LAUDER—It answers his last question. He said he wanted to know of some practical tests that had been made, and I told him that we had just heard of one.

MR. SETCHEL—I am like Mr. Briggs. If we have an engine with 10,000 pounds weight on a wheel, and that engine does a great amount of slipping, and by any device that we can arrange we can put on

15,000 pounds, I should like to have it explained why that is not an advantage, and if there is any member present that can tell why that additional 5,000 pounds is not half as effective as the other 10,000 pounds, I should like to know the theory by which he arrives at that conclusion. We know that manufacturers are often required to put huge castings between the drivers for the purpose of adding weight to certain classes of engines. In some cases they are adding it in the shape of an ash pan. Sometimes I have heard of master mechanics putting on extra thick tires on the wheel for the purpose of adding weight, and they often put on two or three thousand pounds of a foot board. Now, then, for us to allow the statement to go out that four or five thousand pounds of weight thrown from the tank on the drivers is of no value is, I think, all wrong. If the size of the cylinder on the engine is not large enough to slip the wheels when the extra weight is put on, of course there is no advantage in using the traction increaser, but if the cylinder is large enough, I do not see why a traction increaser could be anything but an advantage.

MR. BLACKWELL—In the case of an under-cylinder engine no additional weight would help the power.

MR. BRIGGS—I do not for a moment suppose that by increasing the weight on the drivers we would get any more power, but if we have too much power for the weight, how are we going to increase the weight?

MR. SINCLAIR—I think the Association should favor a better method of getting traction on locomotives than by the use of the traction increaser. A great many engines are suffering from deficiency of adhesion because their cylinders are too large for their boilers, and in most cases of that kind it is malconstruction or bad form of design in building the engine, and it seems to me that it is the duty of this Association to favor improved designs instead of methods for overcoming the defects of bad designing.

MR. JOHANN—I agree with Mr. Sinclair, but I cannot agree with Mr. Lauder that the traction increasor does not give them some advantage. I remember a little incident that occurred many years ago before we used engines as heavy as we do now, where one of my engineers improvised a traction increaser that none of us could tell how he did it. He usually could haul two or three more cars over a hill than any other man with the same kind of engine. Finally, we found out that before he got on to the hill, there was a certain point of the road where there was a frog, and he would run his wheels on to that frog and block them up, and then he would go on up the hill. Now, there is no question. but that a traction increaser will enable you to utilize that power, but, as Mr. Sinclair says, I do not think it is just the right way to do it. My own opinion is that we want to find ways of equalizing the distribution of weight, not by cast-iron foot boards, but by the boiler and more water in the

boiler, and such things as that. I think by that means you will utilize all the weight the engine has on the drivers, and have the cylinders in proportion to that, and no more. Then we have all we can do with that engine.

MR. BRIGGS—Admitting all that, I think that when we go to build new engines they should be built correct; but, unfortunately, we have a great many old engines that we do not want to give up, and we are seeking to utilize them.

MR. SPRAGUE—It seems to me that there are two questions involved in this thing. I don't know whether it is the best way of deciding it to talk about building heavier engines. It would not be much easier on the track or engine to carry that additional weight all the time. Of course there is no standard engine built but what we need a little more weight under heavy pulling, even with new engines. If there is anything in this device, it is a question whether it would not be better to build your engines a little lighter and simply add this weight at certain times, and save both machinery and rails.

MR. SETCHEL—It seems to me that my friend, Sinclair, forgets that every pound of dead weight we draw about the country without its being available for the locomotive is just so much dead loss, and if we could utilize all the water and coal for the purpose of traction, it seems to me it would be a step in the right direction. That, I believe, is what we have all been trying to do, that is why we got up our consolidation engines to utilize the weight. Now, that weight which we carry about in the tank is just as expensive as the weight on the engine, and it is our duty as master mechanics to utilize every pound of weight, not only in the engine but in the tank, if we can do so, whether you call it a traction increaser or what, and it is folly for us to attempt to say that four or five thousand pounds added to the weight on a wheel, if we have not sufficient traction, does not help to make that a better engine, and especially as the generality of our roads are equipped with old style engines, and we have not weight enough to hold them down, how shall we do it? Is it better to throw that power away or utilize that which we have and put the weight of the tank on the drivers.

MR. HATSWELL—This discussion has been very interesting to me. If you put the weight of the tank on the engine, you cannot carry any more cars. We have a device hung on the foot-board with two bars running out, and it goes back as far as the first truck, and sliding across it. We have hung in there the cylinder. The weight of the tank is thrown almost entirely on the engine. It won't stop the engine from slipping, nor it won't pull any more cars. Why is it so? That is a question that I should like to have solved. I have even gone so far as to use cast iron cabs on engines to increase the weight.

MR. SPRAGUE—It seems to me that in that case you did not get the weight on the drivers. I will guarantee that every pound of weight you add to the wheels will add to the tractive power.

MR. HATSWELL—I know I added to the weight of the engine because I broke the springs down..

MR. MCCRUM—About three months ago I put on one of those traction increasers on an engine 17x24. The weight of the engine on the drivers was about 48,000 pounds without the traction increaser. I am sorry I havn't the figures with me of a test that we made, and I won't undertake to say just what the difference in the tonnage was, but we readily conceived that that engine is two cars better with the traction increaser than without. We have a number of engines of the same class that we are expecting to put this device on. We are so favorably impressed with the use of it on one, that we are willing to try it a little further, and it seems to me if there is merit in this device it is better, to only use the weight as necessity requires.

MR. HATSWELL—I am favorably impressed with the traction increaser, and what beats me is that we cannot get the same results with us that they do at other places. I thought it was going to pull two more cars over the hill, but I was disappointed. The reason why I make the statement is that I want to know what is the matter. There must be something wrong, why we cannot get the same results as they do in other places. The engine slips almost as bad with as without it.

On motion of Mr. Lauder, seconded by Mr. Sprague, the discussion was closed.

THE PRESIDENT—The reading of the report of the Committee on Boiler Construction is now in order.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION REPORT OF THE BOILER COMMITTEE FOR 1885.

MR. PRESIDENT AND GENTLEMEN—The slight success that has followed the issue of circulars the last few years, is the reason no circular was issued this year by your Committee on Boilers; its working members believing that a *resume* of the past work, noting the points from which progress had been made, would probably prove interesting and elicit free and general discussion.

STEEL PLATE.

Steel was reluctantly used in 1869 (see p. 10 of report for that year.) But 200 boilers are reported in 1875 (p. 15), and it is

recommended in that year (p. 16), exclusively recommended in 1877 (p. 52), and the committee is unanimous in 1878 (p. 86). In 1870 an opinion from a French engineer was quoted (p. 18), saying that steel plate for boiler use should be capable of hardening. Presumably he was using the metal in barrel plates, and to reduce their thickness and weight, required a metal of high tension which he would secure in a steel that tempered by immersion. But in 1871 (p. 10) the complaint was, that it was manufactured too hard, and in 1875 (p. 16) steel that will not harden is recommended, more especially for fire-box service. The steel we now easily procure and should use for both shell and furnace, has but a small percentage of carbon, say from 15 to $\frac{20}{100}$ of one per cent., and therefore fairly free from silicon phosphorus, &c., will not harden, is mild and ductile, working under the hammer even when cold, most freely, has a breaking resistance of from 62,000 to 65,000 lbs. per square inch of section, with an extension of 24 to 25 per cent. on a length of 10 inches.

A good shop test—in addition to bending over at a point in test piece where it has been punched either cold or after it has been heated and dipped in water—is to take a narrow strip through which a hole one-fifth its width is punched, and then enlarge the hole with a drift and flagging hammer, to fully three times its original punched diameter without splitting the strip. It may be said that there is now no practical limit to the size that steel sheets of desirable quality and thickness can be procured. The C. P. Railway are making the straight portion of wagon top boilers in one plate, and receive sheets 14′ 3″ x 8′, 0″ x $\frac{7}{16}$″, and last year at Erie, Pa., $\frac{3}{8}$″ plates 16 feet long were bent cold in rolls to a curve of 30 inch radius, so that two sheets made one boiler 16 feet long and 60 inches diameter, with but two longitudinal joints in barrel; and Mr. Webb has rolled from ingot and used $\frac{7}{16}$″ steel plate 11′ 3″ wide x 12′ 9″ long in one barrel ring. This practice is in line with the strong recommendation of the Committee in 1871 (p. 14), but as they point out, it requires special rolls to be built for bending the plate.

W. G. S. Strong says he is now constructing a 56 inch straight boiler for 175 lbs. pressure, with all longitudinal seams welded. Welded seams when iron plate and coke fire were used, gave at

least but an ultimate tension of 14 tons and $6\frac{1}{2}$ per cent. extension for 22 ton iron; therefore, it is not a matter of surprise that such a form of joint was seldom used, but now Mr. S. Fox using 22 ton mild steel and common gas flame for heating the scarf, secures a weld having an ultimate tension of 21 tons, and an elongation of $8\frac{1}{2}$ per cent. in a ten inch length, that is an increase of 50 per cent. in strength and 30 per cent. in ductility; although it should be noted that this excellent result is but one-third the ductility of the unwelded steel plate. Some careful experiments show that very mild steel, after annealing, loses somewhat in resistance to ultimate tension and in ultimate percentage of extension, or in other words annealing does not necessarily improve the natural plate. Never-the less if holes are punched in plate, or plate has been flanged or set when warm, mild steel must be annealed. The annealing furnace temperature not being carried too high, a blood or cherry red is quite sufficient, the time in furnace not prolonged beyond the point that will secure thorough and equal temperature, and the cooling not too much hurried by contact with damp earth, or a current of wind at low temperature, neither should there be any attempt to "soften off" by cooling in a bed of saw-dust or ashes

If the flanging, setting, or any other distortion, such as bending in the rolls, can be done cold, there is no necessity for annealing either plates or bars, but all such setting is preferably done under the steady pressure of hydraulic tools.

DRILLING VS. PUNCHING.

In 1872 (p. 19), preference is given to drilling rivet holes rather than to punching, but with the leather-like ductile metal now supplied and within the limits of ordinary thickness of boiler plate used in locomotives, the extra expense of drilling is not justified, and the excess diameter of hole in die over punch need not exceed $\frac{1}{32}$ inch for plates $\frac{1}{2}$ inch thick and under.

RIVETS.

Steel rivets are not reported as being in use in 1871 (p. 12), neither are they used to any extent at this date, yet in view of all the conditions of the case, and until the obscure matter of galvanic action and its influence on corrosion, pitting and furrowing, is more clearly understood, it would be wiser to use steel rivets with

steel plates, thus bringing metals together that are quite similar in nature and electric affinities.

The proportions for riveted joints that suited iron plates, have apparently in many instances been transferred to steel plates of similar thickness, without any serious question as to their similarity, whereas the weight of the evidence (more particularly the elaborate experiments of Prof. A. B. W. Kennedy, for the Institute of Mechanical Engineers) show that to attain a joint of maximum strength a larger proportional rivet area, to resist shearing, is required with steel rivets and steel plates than with iron, the larger diameter however permitting a wider pitch. Thus for single riveted lap joints, the pitch found best is 2.25 diameters of rivet hole, and diameter of hole 2.25 thickness of a single plate, the diameter of the rivet being about 1/32 inch less than the hole. If this proportion should not divide out well, the pitch should be increased to 2.3 or 2.4 diameters. This for a 3/8 inch plate will give a 7/8 inch hole and 2 inch pitch, a wide departure from average practice in iron plates or in steel plates with iron rivets; and the reason for this altered proportion is found (1st), in the fact that in a material so ductile as modern boiler steel, the joint is helped materially by the great (comparative) excess of strength in the plate after holes are cut through; and (2nd), that while the plate is comparatively so much stronger than before, there is no corresponding increase in the shearing resistance of the rivets over the strength commonly found in iron rivets.

The average practice in 3/8 inch iron varies from 5/8 inch rivets with 1 3/4 inch pitch, and 11/16 inch rivets with 1 7/8 inch pitch to 3/4 inch rivets with 2 inch pitch as a maximum. A 2 inch pitch is rarely used for any diameter of rivet, and we know of no practice in 3/8" plate using rivets of larger diameter than 3/4 inch, whereas 7/8 would make a stronger and better balanced joint for very mild steel, and will secure a single riveted joint having 60 per cent. of the strength of the unperforated plate. For double riveted joints (either lap or butt) using a diameter of rivet that is 2 1/4 times the thickness of the single plate, the pitch should be approximately four times the diameter for the thickness of plate commonly used in locomotive practice, the pitch being proportionately narrowed as the tenacity of the plate is higher than 30 (long) tons per square inch.

The position of the second row of rivets should be such that the net diagonal area of plate or area along zigzag line should not be less than 30 per cent. in excess of the net area across the joint, and 35 per cent. is better than 30 per cent.

The general tendency of present practice (a survival from other days and other conditions) is to put too many small rivets in a double joint, as if afraid the joint would leak, but pitches of 3 inches in 3/8 inch plate are tight at 120 lbs. pressure, and in 9/16 inch plates pitches of 4.14 inches are tight at 160 lbs.

POWER RIVETING.

Machine riveting by a single squeeze was not approved in 1871 (p. 70), but the Steam Piston Riveter giving several strokes was. This is now practically superceded by the hydraulic piston, having the merits of the single close squeeze, and the adjustability of the steam piston, producing work of unequaled solidity, and dispensing with the necessity for caulking, as boilers are now turned out tight under test pressures of 160 lbs. A large amount of boiler patching and almost the whole of the work on new tender tanks in position, can be done by the portable hydraulic tools of W. R. W. Tweddell (specifications of hydraulic riveted joints exhibited). A noteworthy point about hydraulic riveting is that even in those cases where it does not increase the absolute strength of the joints, it makes it so much *stiffer* that visible slip does not commence until the pressure is from 100 to 125 per cent. higher than when slip commences in hand-made joints. This explains why hydraulic riveted boilers do so little weeping under high test pressure.

CAULKING.

One source of danger in boiler manufacture is erroneous joint caulking (both inside and out), with sharp-nosed tool so close to inner edge of plate as to indent, and in many cases actually cut through the skin of the lower plate. The old style of caulking, that put a positive strain upon the rivets commencing distortion and putting excessive stress upon (rivets already in high tension) before boiler commenced work is, we hope, fast becoming a thing of the past. With a proper proportion of diameter and pitch of rivet to suit steel, all that is required is the use of a light fuller as shown on sketch No. 1, fig. 3 (used by Mr. Webb, L. & N. W. Rail-

way), which does not force the joint. The use of round-nosed tool No. 2 (of which some good work was shown at the Centennial Exhibition at Philadelphia) is not as good, but is infinitely better than caulking tool No. 1, which has often started cracks that worked inwards or resulted in furrowing. There is but little need for caulking if means are taken to secure a clean metal-to-metal face at the joint. When the plates are put together in ordinary course of manufacture, a portion of the mill-scale (black or magnetic oxide) has been shaken off, but part is left on and this is reduced to powder or shaken loose in the course of riveting, and left between the plates, thus offering a tempting opening for the steam to work through and is really the cause of the heavy caulking that puts so unnecessary a pressure on both plate and rivet. A clean metallic joint can be secured by passing over the two surfaces, waste wet with a weak solution of sal-ammonica and hot water, an operation certainly cheap enough both as to material and labor required. This practice has been carried out with success for years on the L. & N. W. Railway.

The result of such practice is that the riveted joint can be allowed a wider margin beyond outer edge of rivet, the rivets themselves to have a larger diameter which mild steel absolutely requires, and the rivets to be pitched correspondingly farther apart, as the pitch has often heretofore been controlled more by the resistance required to meet the heavy use of the old caulking tool, than settled by an investigation into the best proportion to secure the utmost strength for given thicknesses of the good material that is now almost exclusively used in locomotive boilers.

CROWN STAYS.

Crown stays should be "double-plated transverse girders one inch clear of sheet" said the Committee in 1869 (p. 10). In 1871, however, the troubles incident to this class of stays are fully recognized (p. 15), and the recommendations are for bars to be fewer and stronger, entirely supported from outer shell, that the clearance underside be increased, and that washers and distance ferrules be dispensed with.

If this class of stay is to be used, nothing better is shown than the solid steel crown bar castings (1883, p. 80), but your Committee

cannot but continue to emphasize their recommendation to the use of rods, screwed through both crowns, with their ends rivetted over—a plan so old as to have been used in Stephenson's "Rocket" in 1829, and for which a patent was granted in 1848. In 1871 (p. 16) this system is said to be weak, but your Committee have been looking for a case of failure in this class of staying, without success, even in boilers that have the two crown sheets so far from being parallel that the stay is a long way from being perpendicular to either sheet. In fact, an angle that permits of but one perfect and complete screwed thread for a continuous circumferencc, will—if the rivetting over be carefully done—prove sufficient to last out the inner fire box. Bolts with their heads on the inside of the inside fire-box may be safer (see 1880, pp. 61, 62, 68, and 1881, p. 64), but we doubt the necessity for this excess of strength, and so made it is more difficult to use the twist drill socket for screwing the stays into plate, as this tool must then be used from the inside of fire-box instead of from the outside.

Mr. Urquhart, M. S. of the G. & T. Railway, Russia, who is burning petroleum refuse (black oil) with such great success in more than 100 locomotives, says that as one of the results of the high temperature attained in his fire-boxes, many nuts on the stay bolts of roof dropped off, after which he made heads on the lower ends of these roof stays; but he goes on to say that the best arrangement is Belpaire's, where the stay bolt is screwed into both plates and rivetted over, thus allowing a free circulation of water over the hottest part. It is to be noticed that many years ago nuts were used on the ends of the screwed stays of fire-boxes burning anthracite, but they are now superceded by rivetted heads, and the experiments carried out by the U. S. Navy in 1879 (see Secretary's Report) prove that even if snapheaded or buttonset they are quite strong enough for their work. The curving and sloping backward of crown sheets, though not approved of in 1871 (p. 16) still recommends itself by offering additional facilities in washing off the sheet.

FLUES.

Steel flues were but slightly used in 1870 (p. 105), and their use at present is not common. They are thin, give a lengthened serv-

ice, and in the hands of a good workman are (with borax as flux) readily pieced and rewelded to iron ends. Difficulty in rewelding was the chief defect mentioned to their discredit in 1873 (p. 43). The statements of Messrs. Robinson and Eddy, in 1873, (p. 43–4), that brass flues transmitted heat more freely to the extent of justifying, as economical, the use of the more expensive metal, remains unproven to date, and after much experimenting the almost uniform practice of this Continent in the use of iron and steel flues contradicts it.

The securing of flues is now an almost uniform practice, viz: parallel, expanding with roller expander and beading the ends over, the fire-box end being encircled by a ferrule $\frac{1}{16}''$ or less thick, of soft iron or copper preferably, brazed to the end of the flue; but the distance flues should be spaced apart varies widely, the best evidence going to show economy in the wider spacing up of ⅞ inch water way, and Mr. Faries, in 1875 (p. 59), and Mr. Adams on the North London Railway, make a good show for one inch spaces.

HEATING SURFACE.

Mr. Towne in 1872 (p. 64) said (and it was not disputed), that the flues were acknowledged the most effectual heating surface of the boiler. This view is not held by those who, going to the opposite extreme, say, with the Gauge Commissioners, that every square foot of fire-box is capable of evaporating two cubic feet of water per hour, experiment having shown that an excellent evaporation for the whole surface (fire-box and tubes combined) per square foot is ⅛ of a cubic foot per hour, or for 1,000 feet of surface 125 cubic feet=940 gallons (U. S.) The most common assumption is that the relative values of the flue and fire-box surfaces are as 1 to 3; but Mr. Longridge, in a paper before the Institute of Civil Engineers, analyzed the actual work of nineteen locomotives, from which he found the hourly evaporation from the fire-box surface was as 11.7 to 1, the total average tube evaporation was $.1365 \times 11.7 = 1.597$, or in other words, with common sizes under ordinary work and with ordinary blast pressure, the fire-box evaporated $\frac{1}{5}$ and the tubes $\frac{4}{5}$ of thewater; consumption of fuel per square foot of grate varying from 38 to 157 pounds, the average being 83 pounds. One of his conclusions was that a large increase of heating surface in proportion to the fuel burnt only slightly increases the economical effect; in

fact, within the limits of common practice in locomotives, the economic effect is in proportion to about the fourth root of the heating surface. For instance, an increase in heating surface from 915 feet ($\sqrt[4]{}=5.5$) to 1296 feet ($\sqrt[4]{}=6$), or of 381 feet would only give an increased economy of $\frac{1}{11}$ or nine per cent. for the same consumption of fuel. The case of course would be different if both engines were being forced heavily, or a greater amount of coal being burnt per foot of grate, then the greater absorbing surface would give a higher relative economy.

BLAST PRESSURE.

Mr. O. Busse analyzed some experiments made on the Northern Railway of France with an old locomotive boiler, having 76½ square feet of surface in fire-box, and 717½ in 125 tubes 12 feet long, $1\frac{4}{5}$ diameter. The tubes were cut off by bulk-heads into four sections of about 3 feet long, and having nearly 180 square feet of surface; the evaporation was as per table; the blast pipe in smoke box being supplied from a second boiler. One noticeable fact is that the vacuum in smoke box measured in inches of water is increased 400 per cent. without increasing the total evaporation of water 100 per cent. The greater consumption of fuel and the greater speed of smoke due to the highest vacuum improves the evaporative efficiency of the tubes at the outer end 200 per cent., but at best their efficiency is not high, the last 3 feet length having but from $\frac{1}{5}$ to $\frac{1}{6}$ the evaporative value of the first length.

TABLE No. 1.

Vacuum in Smoke Box measured in inches of water.	TOTAL EVAPORATION IN LBS. OF WATER PER HOUR.						
	SECTIONS IN BARREL COMMENCING IN FIRE-BOX END.				TOTALS.		
	1st.	2d.	3d.	4th.	Tubes.	Fire Box.	Grand Total.
.78	57	26	14	8	107	252	360
1.56	82	44	23	15	165	300	465
2.34	118	48	38	25	230	410	641
3.12	105	55	34	25	220	461	681
3.90	149	68	46	30	294	417	712

Putting this statement into the form of percentages of total evaporation (and as before ignoring decimal points) we have:

Vacuum in inches of water.	1st per cent.	2d per cent.	3rd per cent.	4th per cent.	Total of Tubes per cent.	Fire Box per cent.	Grand Total per cent.
.78	15	7	3	2	30	70	100
1.56	17	9	4	3	35	64	100
2.34	18	7	6	3	36	64	100
3.12	15	8	5	3	32	67	100
3.90	21	9	6	4	41	58	100

The pounds of water evaporated per square foot of heating surface per hour were:

Vacuum in inches of water.	In Fire Box.	No. 1.	No. 2.	No. 3.	No. 4.
.78	3.30	.32	.14	.08	.05
1.56	3.92	.45	.24	.12	.08
2.34	5.36	.65	.26	.21	.14
3.12	6.02	.58	.30	.19	.14
3.90	5.45	.83	.38	.25	.16

These comparatively small quantities should be compared with the eighteen pounds of water per square foot of surface (tubes and fire-box) evaporated in Torpedo boilers with six inches of water pressure in stoke hole.

It is quite possible that testing the evaporation of independent lengths of the boiler by the use of bulkheads gives a misleading result, as the partitions seriously interfere with the circulation; circulation being a far more important factor in the transmission of heat than either the nature or thickness of the metal through which heat is transmitted.

With Mr. Busse's figures should be compared the Government experiments carried out with Mr. Tharneycraft's torpedo boat boilers of locomotive type having air pressure in stoke hole. These boilers have 620 sq. ft. of heating surface, of which 56 feet is in fire box. Grate surface 18.4 ft., barrel 53 inches diameter, tubes 205, of 1¾ inches diameter and six feet long.

TABLE No. 2.

Air pressure in stoke hole in inches of water .	2	3	4	6
" " ash pit " "	1.47	2.29	3.26	5.25
" " furnace " "	1.35	1.87	3.0	4.33
Temperature of feed water, Fahr.°	53°5	57°	54°	56°
" in funnel, "	1.037°	1.192°	1.260°	1.444°
Steam pressure above atmosphere, in lbs . . .	117	117	115	115
Coal consumed per hour, " . . .	925	1.177	1.472	1.815
" square foot of grate, " . . .	49	62	78	96
Water evaporated per hour—total " . . .	6.530	7.770	9.320	10.840
" " lb. of coal, " . . .	7.06	6.6	6.33	5.97
Evaporation per lb. of coal reduced to equivalent at 212° Fahr. from 100° . . .	7.61	7.08	6.81	6.41
Evaporation per h'r per sq. ft. of heat'g surf'ce.	10.8	12.9	15.5	18.0
	H. M.	H. M.	H. M.	H. M.
Duration of experiment in hours and minutes .	2 : 0	2 : 7	1 : 39	1 : 27

Coal used, Nixon's Navigation. Ashes, 9 per cent.

The results would have been more interesting had lower pressure than 2 inches of water been used, as even at half engine power these boilers are overworked, but the influence of pressure on evaporation, combustion and temperature is clear, and the experiments showed that tubes absorb $\frac{7}{10}$ and fire and grate bars $\frac{1}{10}$ of initial pressure. The pressure in chimney was about equal to the pressure of atmosphere. Additional experiments were made to see if the ordinary mode of forced combustion with steam blast in chimney approximated in efficiency to pressure in stoke hole, with the result of showing that steam jet was very wasteful, usually only increasing consumption on grate 40 to 50 per cent over natural draft, with an increase of efficient power not exceeding 15 per cent.

Turning fan air blast of 12 inches pressure and more into chimney and using locomotive nozzles, and split-rings from 2 to 5 inches in diameter, result was poor, the best show being made with a 3½ inch nozzle, but even that not one-half of what was obtained with 2-inch pressure in stoke hole. This result accords with Mr Longridge's statement that the blast pipe considered as a motive power is very wasteful, as but from $\frac{1}{11}$ to $\frac{1}{12}$ of the power escaping is utilized in drawing air through the tubes. It should be noted (see table No. 2) that an increase of blast pressure from 2 to 6 inches or 200 per cent. did not increase the consumption of coal per square foot of grate quite 100 per cent. and the value of the fuel is reduced 15 per cent.

HOLLOW STAYS.

The difficulties in the manufacture of hollow stays and the unvarying supply of air admitted—although the supply should be adjustable to varying demands of the fuel—have not encouraged their use (see 1872, pp. 19, 61, 62; 1877, pp. 117, 129, 130; 1878, p. 96; 1879, p. 80), and a fire hole deflector with adjustable door or diaphram still proves the better plan for admitting the air required above the fuel.

SCALE.

After continuous reports of non-success with chemical compounds to remove or prevent formation of scale, the recommendations of former committees (see 1873, p. 18, and 1874, p. 42) are narrowed down to the use of pure water and providing open surface storage reservoirs to secure it, and washing boilers out when cold with water of heavy pressure to detach all mud and scale; however, in 1869 (p. 49) there is a report that Hays' Battery will soften scale after formation. Batteries, although perfect in theory, have heretofore been found deficient soon after they have been put to work through the mechanical difficulties of getting pure zinc and keeping it in clear metallic contact with some point of iron, oxide of zinc rapidly forming at the junction, thus breaking the contact absolutely necessary for a galvanic couple and electric current. The zinc is well hammered at a definite heat which changes it from a crystaline friable metal to a malleable one, and insures its long existence in an efficient condition. This in the ocean service of the Canadian Mail Line has stopped the further action of corrosion and loosened old scale. We have not to fight against salt or fatty acids in locomotive boilers, but its success in bad marine boilers justifies experiment being made with it on locomotives. The theory explaining its action in detaching scale is, that at the surface of the iron plate (the negative pole) water is slowly decomposed and the hydrogen gathers and forces off the new scale as soon as it is thick enough to offer resistance. Of all boiler plate preservatives used by the Admiralty, zinc has proven to be the most effective. It has been used in rolled slabs 12"x6"x½", and one slab per 20 I. H. P., or one part square of slab to two feet of grate surface.

PITTING.

Pitting can be stopped and the plate brought into a healthy condition by scraping the affected spots and cleansing the surface with a strong solution of soda or petroleum to remove any grease or acidity, and then coating with a thin wash of Portland cement. Even so simple an expedient as filling the cleansed pit holes with red lead has, in marine practice, proved quite effectual in preventing any further waste, and as corrosive and pitting action are apparently increased by the partial absence of oxide or scale on the plate, and the whole of it cannot be kept on, due to the handling the steel receives in boiler making, the better, and certainly the safer practice, is to remove it completely by washing with a very weak acid solution, protecting the raw metallic surface by rubbing over with black oil (still refuse.) Such a surface is less liable to obscure galvanic action, and as long as it is kept clean will certainly transmit heat and deliver it to water more freely (see R. Wells' experiment, 1876, p. 80). That there was less pitting in steel than iron boilers was Mr. Sedgley's opinion (1877, p. 54), and recent experiments and extended experience and observation tend to confirm this statement, except when local galvanic action is started, and galvanic action will not start, or at least will not give any trouble, when like metals are acted upon under similar conditions; therefore iron rivets should not be used with steel plates.

FURROWING AT JOINTS.

This subject has been much discussed (see 1872, p. 56; 1877, p. 61; 1878, p. 73, etc.) with the resultant opinion that furrowing was due to chemical or corrosive action on a surface or point at which expansion or alteration of shape was localized. In addition to the cause before given for this localization, we would call attention to the injury done to barrel plate at the line of rivet holes, in passing it through the rolls after drilling or punching, the lessoned resistance there permitting the end of plate to make a decided set, instead of bending uniformly to curve, such rough measures are occasionally used by careless workmen in bringing the bent edges back to true curve as to make a good opening at this point for acids to work upon.

RECENT EXPERIMENTS.

Experiments have been carried out on the C. R. I. & P. Railway with the Coventry Boilers, illustrated by plate 27, page 42 in Seventeenth Report, and Mr. T. B. Twombly, under date of March 12th, writes the Committee as follows:

"In reply to your inquiry regarding Coventry Boilers, will say that this engine ran some 2,000 miles on our road. I did not subject her to any scientific tests, but run her for six hundred miles on freight service against our engine No. 291, carefully weighing the coal to each engine and having them pull trains of thirty loaded cars each way, cars of as nearly same weight as possible. The result appears on the small blue print enclosed, which shows that our engine ran 36.98 miles to a ton of coal and the Coventry 33.24 miles.

"The engine was handled by one of our engineers who knew the road perfectly, and although he might have done somewhat better had he been more acquainted with the engine, yet I consider this a fair practical test. I think it reasonable to presume that no amount of fine handling would cause her to show any decided advantage over our engine. The Coventry Boiler is 60 inches in diameter, placed on an ordinary 8-wheeled engine with cylinders 17"x24", and weighs something over 40 tons. Our engine, No. 291, has a boiler 50 inches in diameter, cylinders 17"x24", and weighs 36 tons. I made no investigation into her evaporation. A man employed by Mr. Coventry put a pyrometer in her front smoke box close to the flue sheet, and he reported 900° of heat when engine was working hard, dropping down to 400° when working lightly. Of course I do not know how accurate this is.

"She ran for a week or two on one of our suburban trains, doing very good work and throwing very few sparks. She is a nearly perfect spark arrester. She ran one trip on one of our heavy express trains (twelve cars) and lost time each way. She is not what would be called a free steamer. It requires considerable more work in the round house to keep her cleaned out, than it does with the ordinary boiler, as her back smoke box fills with cinders, which must be shoveled out of a small door, and her flues seem to fill up very fast. The original cost and cost of repairs will be considerably more than on present style of boilers, and altogether I do not think

that as at present constructed her advantages will compensate for the increased trouble and expense."

COPY OF BLUE PRINT.

C. R. I. & P. Engine, No. 291.	Coventry Engine.
1884. Nov. 13, 9,400 lbs. coal taken. " 13, 4,000 " " " 15, 9,150 " " " 17, 11,150 " " " 17, 4,000 " " 37,700 lbs. total coal taken. 5,250 " coal left over. 32,450 " " used.	1884. Nov. 13, 8,100 lbs. coal taken. " 13, 4,000 " " " 15, 9,700 " " " 17, 11,300 " " " 17, 4,000 " " 37,100 lbs. total coal taken. 1,000 " coal left over. 36,100 " " used.

C. R. I. & P. Engine, No. 291.	Coventry Engine.
Miles run, ... 600. Miles to 1 ton coal, ... 36.98.	Miles run, ... 600. Miles to 1 ton coal, ... 33.24. Percentage of work performed as compared with Engine, No. 291 .90.

Inclosing this report the Committee wish to state that the credit for the labor expended in collecting the material for this review, and the working it into shape is entirely due to Mr. J. Davis Barnett, one of the members of the committee. They also desire to return their thanks to Mr. T. B. Twombly, Gen'l M. M. of the C. R. I. & P. Ry., for his kindness in furnishing the experimentary notes on the result of the trial with the "Coventry Boiler."

Respectfully,

JACOB JOHANN,
J. DAVIS BARNETT, } Committee.
ALLEN COOK,

On motion of Mr. Sprague, seconded by Mr. Lauder, the report was received.

THE PRESIDENT—It is so late that perhaps it would be well to suspend discussion on this report for the present. The Secretary has some minor matters to present.

Mr. Setchel read the report of the Auditing Committee.

WASHINGTON, D. C., June 16, 1885.

To The American Railway Master Mechanics' Association:

GENTLEMEN:—Your Committee appointed to audit the accounts of your Secretary and Treasurer beg leave to state that they have attended to the duty assigned them and find them correct as stated in their reports.

N. E. CHAPMAN.
J. M. BOON.
W. F. TURREFF.

On motion of Mr. Lauder, seconded by Mr. Sprague, the report was accepted, and the Committee discharged.

MR. SETCHEL—I have a letter from our venerable member, Isaac Dripps, transmitting to the Association drawings of boilers that he made in 1835.

3324 WALNUT ST., PHILADELPHIA, PA., MAY 18, 1885.

J. H. Setchel, Secretary American Railway Master Mechanics' Association:

MY DEAR SIR:—I take the liberty to enclose to you three tracings of Locomotive boilers.

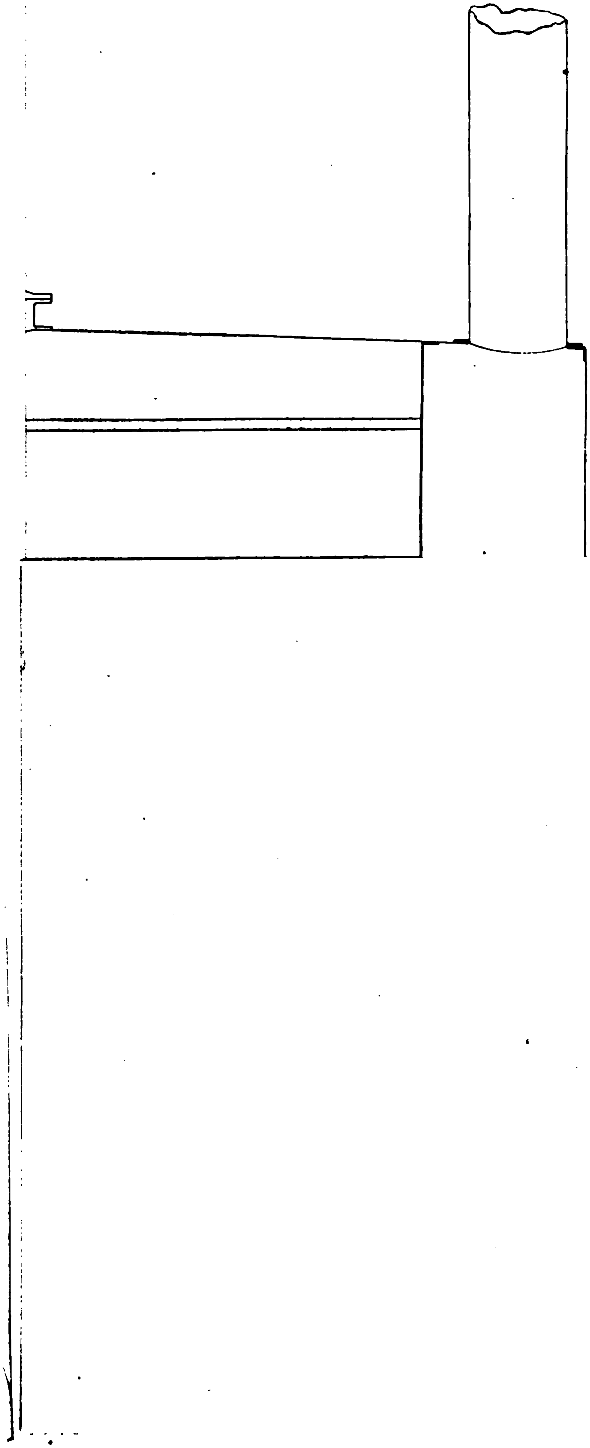
Plate No. 1 shows a boiler for burning anthracite coal for 18x30 inch cylinder freight engine, built in New York in 1835 for the Camden and Amboy R. R. Company. The furnace of this boiler at its front end and some distance back from the tube sheet had a bridge wall, or water space extending upwards to within 13 inches of the crown sheet.

Between the bridge wall and tube sheet was a combustion chamber.

The boiler as constructed was very deficient in making steam, and after being in use some time she blew off the dome breaking through the cast iron throttle valve at the bottom of the dome and doing other damage.

In rebuilding the boiler I altered the combustion chamber into a small fire-box, by cutting away the bottom of the boiler between the tube sheet and the bridge wall placing the grate bars low down and putting a fire door on the right side of the boiler, as shown on Plate No. 2.

The bridge wall or water space being so high, that is so near the crown sheet, gave me sufficient room to raise the grate bars of the main or back fire-box.



The above alterations of the boiler, with the use of the exhaus-jet-box, inside of the smoke-box (as shown on Plate No. 2) and tapert ing smoke-pipe, increased the steaming qualities of the boiler very satisfactorily.

This was the first time the above mentioned exhaust jet-box was ever used.

The engine was one of novel construction. She had no solid frames as are now used. The pedestals for journal-boxes of main driving shafts were made of heavy plate iron, extending low down and riveted to both inside and outside legs of boiler.

The cylinders were fitted to the boiler just forward of the small fire-box. The front end of the boiler was supported on truck as follows: On the bottom of the boiler, back of the smoke-box there was fitted a cast-iron saddle, united to the skin of the boiler with a centre pin keyed into it.

The saddle fitted into and rested on the centre plate of truck, with the centre pin passing through the centre plate. Tracing Plate No. 3 shows a boiler for burning anthracite coal for 14 x 38 inch cylinder, passenger engine No. 38 Camden and Amboy R. R. Company, on a single pair of driving wheels 8 feet in diameter.

Inside the dome of this boiler, on top of the steam pipe, and below the throttle valve was placed a device to prevent any water from passing into the cylinders while the boiler was foaming.

The water when carried up with the steam would be intercepted by the curved surface of the deflecting plate at the top of the steam pipe, and being forced to flow passed the curved surface with considerable velocity would be deflected downwards to the bottom of the boiler by a pipe, as shown on plate.

The boiler also had two sets of tubes separated by a combustion chamber as shown. I am very respectfully yours,

ISAAC DRIPPS.

On motion of Mr. Setchel, seconded by Mr. Lauder, the letter and drawings were received and ordered printed in the report, and the thanks of the Association tendered to Mr. Dripps.

MR. LAUDER—I desire to say that I think all old drawings should be preserved. I presume that there are and have been lots of devices which those drawings describe perfectly. There are lots of new inventions springing up every day, which no doubt are represented by drawings made in 1835, showing the inventions to be of no earthly

value. Now, if we have those things we can choke off a great many of these so-called new inventions when they come up. I hope the Convention will have it understood that any one who has drawings of old devices, old spark arrester, grate bars, etc., will give the drawings to us and we will publish them in our annual reports, because there are lots of things being patented every day that are old as the hills, and which are of no use whatever, and this record will be valuable for refuting claims to originality.

MR. SETCHEL—Mr. President, as we have had a long, hot session, and as the hour for adjournment has arrived, I move that this Convention do now adjourn until to-morrow morning at 9 o'clock.

MR. SPRAGUE--I second the motion.

Carried.

The Convention then adjourned until to-morrow, June 17, at 9 A. M.

SECOND DAY.

The Convention was called to order by the President at 10 A. M.

THE PRESIDENT—Discussion on the report of the Boiler Committee is now in order.

MR. SETCHEL—As all the members are not here at this time, and as there is a little preliminary business that might be attended to, I would suggest that committees be appointed as follows: On place of meeting; on nomination of officers, and I would also remind the Committee on Subjects that they are to report. I have here a communication for associate membership. There is also a paper from our associate Willard A. Smith. Mr. Smith wishes to get away to-day and he would like to have his paper taken up out of the regular order of business and be given a chance to read it before he goes. I think it will add to the interest to have as many members present as possible when the Boiler Committee's report is discussed, and therefore I think these other matters better be taken up and disposed of first.

MR. LOCKWOOD—I have a communication to present and would place it before the Convention now, that it may be referred to the Committee on Associate Membership, and I will confer with them in relation to it.

The Secretary read the paper which was the application of Robert Grimshaw for associate membership.

On motion of Mr. Sprague, seconded by Mr. Whitney, the same was referred to a committee.

THE PRESIDENT—I will announce this committee in a few moments.

MR. SETCHEL—I move that a committee on next place of meeting, and also a committee on nomination of officers be appointed.

MR. LAUDER—I second the motion.

Carried.

THE PRESIDENT—I would nominate as members of those committees the following: On next place of meeting: H. L. Cooper, H. D. Gordon, and R. H. Briggs. On nomination of officers: J. N. Lauder, William Swanston, and David Clark.

The Committee on Subjects are, I believe Mr. Boon and Mr. Twombly. I don't know whether any member of that Committee is in the hall at present, but I wish to remind them that their report is due this session and we shall be glad to receive it as early as possible.

Mr. Lauder—Mr. President: It is proposed to have an excursion for this Association on the Potomac River to Mount Vernon, and the Committee who have the matter in charge would like to have the Convention express its wish as to the time when they can best go on that excursion. There are two propositions; one is that we adjourn to-night until four o'clock on Thursday, and take the excursion, occupying the day before that hour, and when we return, go on and close up our business. The other proposition is to close our business to-day and to-morrow, and take the excursion on Friday.

I make this explanation before making my motion. I now move that we close our business first, and if an excursion is provided it shall be taken on Friday.

I do not think we ought to let an excursion of this kind, or any other entertainment, interfere with the proper conduct of the business of this Association. If we should go to-morrow the result would be that when we returned we would all be fagged out and tired and in no condition to transact any business, and it might entail an extra session on Friday, which would consume more time than to finish our business first.

I hope the good sense of this Convention will sustain my motion, which is that we close our business to-morrow and then take the excursion if it is provided, on Friday.

Mr. Sprague—I second the motion, and in doing so I desire to say that, while we deeply appreciate the courtesy of the Committee who are providing for us here, we must remember that the business of the Association is of primary importance and must be first disposed of before we allow pleasure to take up our attention.

Carried.

Mr. Setchel—I have a communication from General E. S. Greeley, referring to a matter similar to that which has just been disposed of. I suggest that it be read at this time.

Willard's Hotel, Washington, D. C., June 17, 1885.

J. H. Setchel, Esq., Secretary Master Mechanics' Association, Willard's Hotel:

Dear Sir:—I have the honor to hand you herewith a note from Colonel Lamont, Private Secretary to President Cleveland, in reply to a request made in behalf of the lady friends of the members of your Association to meet the President this morning. I have no doubt but what the President will be equally glad to see as many of the members as may desire to take this opportunity of calling on him.

Yours truly,

E. S. GREELEY.

EXECUTIVE MANSION, WASHINGTON, JUNE 16, 1885.

DEAR SIR:—Responding to your note just received, you are informed that the President's engagements for to-morrow will occupy his time until one o'clock, when, as is his custom, he will receive in the East room, and that he will be glad to see the ladies of whom you write, at the hour above named, if they desire to call.

Very respectfully,

MR. E. S. GREELEY, "Willard's."

DANIEL S. LAMONT, Private Secretary.

MR. SETCHEL—Since writing this, Gen. Greeley informs me that he has received another communication from Col. Lamont saying that the President will also be glad to receive any members of the Association that desire to call at one o'clock to-day. In order to do this, I would suggest that this Association take a recess at one o'clock, to meet again at three.

MR. LAUDER—Would it not be well to adjourn at half past twelve, so as to have an opportunity to get ready? We would not want to keep the President waiting for us. It seems to me that we should do this, because the hour between twelve and one o'clock, we devote to outside matters and perhaps we had better take the recess at this time, and that would give us time to get our ladies ready. It is very necessary that we should be at the White House promptly.

MR. SETCHEL—I will change my motion, and move that the communication which I have read be received and that this Association adjourn at twelve o'clock, to meet again at this place at three o'clock so as to allow us an opportunity to call upon the President.

MR. HATSWELL—I would second that motion.

MR. GORDON—If we are to go in a body would it not be well to have some place where we shall meet?

MR. LAUDER—I would suggest that we should go there in a systematic manner. We ought to get our ladies and be prepared to start at half past twelve. We ought also to have some one to introduce us, that the President will not mistake us for a lot of office-seekers.

THE PRESIDENT—I have no doubt that General Greeley will attend to that for us.

GEN. GREELEY—I would say for the information of the Convention that the arrangements have been made for the proper introduction, and if the gentlemen and their ladies will assemble in this hall and go from this side of the building directly to the President's house everything will be in readiness there to receive them. The proper introduction will be made and all arrangements have been attended to in that direction.

The motion to adjourn at twelve o'clock and call upon the President was then put to vote and carried.

THE PRESIDENT—I would nominate on the Committee to Receive Propositions for Associate Membership the following: J. Johann, G. W. Stevens, and W. Lewis.

I hope these members will take the earliest opportunity of meeting together and let us have their report as early as possible.

I would now call upon our associate member, Mr. Willard A. Smith, to read his paper.

LEGAL REQUIREMENTS UPON THE MECHANICAL DEPARTMENTS OF RAILWAYS.

Recent legislation and decisions of the courts have made manifest an increasing disposition, on the part of the makers and interpreters of the law, to hold railway companies responsible for a high degree of perfection, not only in their methods of operation, but also in the machinery which they employ. On the subject of this legal responsibility, there seems to be in the public mind considerable misinformation; and on the part of railway officials, to some extent, a lack of definite knowledge. It is true that questions arising under this head are of such varying natures and influenced by so many circumstances of fact, that it is difficult, often, to determine just what the results of a suit for damages, in which it is involved, will be. It is also true that, when a case actually arises, it must be left to the legal department of the road to handle. But as prevention is better than cure, and the results of ignorance and negligence are altogether out of proportion to the amount of labor and care required to avoid them, it is certainly desirable that the officer in charge of the mechanical department of a road should understand clearly the relations in which it stands to the law.

It is the intention of this paper to present briefly and without legal technicalities, the principles of the law on this subject as they exist to-day; and something of the future tendency.

It is not uncommon for an inventor or the promoter of a new invention to say, "The law will force railway companies to use my device; even if there is no special legislation for it, the courts will hold railway companies responsible for accidents which might have been prevented by its use; and, therefore, they must come to it." This kind of argument is constantly used in the endeavor to induce capital to invest in so-called improvements; and has no

doubt, led to much injudicious investment. At the other extreme are those railway officials who do not recognize the existence to any legal obligation except that which is directly expressed in statutory law, and forced upon their attention by strict and well-defined penalties.

The common law relating to the responsibility of carriers of merchandise and passengers, antedates the existence of railways. When the stage coach was superceded by the locomotive, the general principles of the law relating to carriers, remained the same; and were only changed so far as necessary in application to conform to the new conditions. The earlier decisions were inclined to hold railways to a higher degree of care than stage lines, because steam was considered a more dangerous servant than the horse; and the greater the risk the greater should the precaution be. In later times, the tendency to require greater care has been due to a recognition on the part of the legislatures and the public of the increasing comparative value of human life.

In the progress of civilization it is not improbable that this tendency will continue to grow until, ultimately, negligence may come to be considered synonymous with crime; and dollars and cents will not balance the scale against humanity. A world which has realized so much from inventive genius and expects so much from it, will not tolerate any kind of obstruction to its full fruition.

There are two general divisions of injuries for which a railway company may become liable in damages—those to property and those to persons. With relation to goods received for transportation little need be said. Under the common law, the carrier is absolutely the insurer against all loss except from "act of God," (as by lightning) or the public enemy. In modern practice, the carrier limits the liability by special contract contained in the bill of lading; but he cannot avoid liability for his own negligence. The railway company has the strongest possible financial considerations for endeavoring to avoid injury to merchandise. The cases in which it can excuse itself for any loss or injury thereto are comparatively few.

Merchandise delivered to a railway company for transportation is wholly within the control of that company. Not so with passengers; they are endowed with reason and the power of locomotion.

These powers they may exercise for their own safety or they may neglect to use to their own injury. A passenger may place himself in a position of danger, notwithstanding the greatest effort of the carrier to prevent him from doing so. Hence he must be held responsible for his own safety as far as it lies within his power; and contributory negligence on his part will relieve the railway company from liability. But, aside from this, the carrier is held to a very high degree of care, not only in the operation of the road, but in the selection or manufacture and care of its machinery and all its appliances. The railway company does not absolutely insure the passenger; but it does insure him against all risks to its own neglect.

It is in the interpretation of this word "neglect" that the gist of the matter lies. Various expressions have been used by the courts in defining the degree of care required of a carrier of passengers; and these have passed into the text-books of the law. It is said that the carrier is "held only to the utmost care of a cautious person;" that it is "liable only for want of due care, diligence and skill;" and that it is responsible "only as far as human care and foresight will go." These are general principles requiring further elucidation. The law does not require anything which is physically or morally impossible; nor a degree of perfection which may be ideal but is not practicable. It considers that the business of a railway is to furnish transportation; and does not require an expenditure and responsibility so great as to make the business impracticable. It also considers the position of a railway and does not require so much in the way of expenditure from a small road with light traffic as it does of a great trunk line. In other words, it follows the dictates of common sense in determining the exact meaning of the word "duty." These imitations, however, are not intended as loopholes for escaping responsibility, and within these lines a strict account is held. In general terms, it may be said, that a railway company must be abreast of the times. In the construction of its machinery it must, in the first place, exercise the greatest care in the purchase of materials. The most approved tests must be used, and quality must be considered before price. It would doubtless be considered negligence for a railway company to purchase and use a wheel costing only seven or eight dollars, when the best expert

testimony was that a good reliable wheel could not possibly be made for less than ten or twelve dollars. Such action would betray a recklessness which no court could excuse. It has been held that axles must be tested by the most approved methods in use; and that a railway company "must apply to boilers of locomotives every test recognized as necessary by experts." And this lialility is not avoided by purchasing machinery already made, from manufactures. The negligence of the manufacturer attaches to the railway company buying and using his machinery. Nor will the high reputation of the manufacturer avail the railway company as a defense.

The only exception to these rules is in the case of "latent defects which could neither be guarded against in the process of construction nor discovered by subsequent examination;" and this will be construed in the light of the highest scientific skill. Many defects which were once considered latent can now be discovered; the causes are known and can be guarded against. Such cases will be considered with reference to the "present state of the art"—ignorance of which is no excuse. So, when a machine or vehicle has been put in operation, continual watchfulness is required, and a cautious observance "of all accustomed and known tests for the discovery of their insufficiency, as often as circumstances require." In an interesting case, the tire of a driving wheel had been tested when new; subsequently it was re-turned and not again tested. It was held that the neglect to make this second test rendered the railway company liable for an injury resulting from the breaking of the tire. The factor of safety must be sufficiently large to cover all the probabilities, if not quite the possibilities, and no chances must be taken.

We now come to the important question in how far a railway company is legally bound to adopt new inventions and improvements. The rules governing this subject has its limits; but within those limits it is one of great and growing importance. The courts are more and more inclined to hold carriers to a strict responsibility, and this is being supplemented to a considerable extent by legislative action. Generally speaking, a railway company is under legal obligation to adopt such new inventions and improvements in the construction of its equipment, as will conduce to the safety of travel. This does not, however, cover every possible device, or any which are only theoretical or in the experimental stage. It is

not obliged to experiment with everything which looks well, nor to accept the mere experiment and limited experience of others. Nor is it obliged to use any device which might accomplish its object in one direction, but at too great a risk or actual detriment in others. It must keep up—not with the very highest scientific skill, nor the most advanced flight of inventive genius—but with the actual and general mechanical progress of the times. The law requires the adoption and use of such inventions and improvements as are well-known and generally approved—as for instance, continuous power brakes, platforms which prevent telescoping, and many other devices which will readily occur. But there are always a large number of inventions in existence which have not been demonstrated to be successes, and concerning the value of which there may rightly be a difference of opinion. It thus appears that success is the criterion which the law applies; and that it is not to the earlier stages of the history of an invention that it is aided by this principle, but after it has really won practical recognition.

The same principle regarding the adoption of inventions applies to other classes of injuries besides those to passengers. Neglect to use suitable gates at crossings; valves for preventing the noise of escaping steam which frightens horses; spark arresters for the prevention of setting fire to property along the track—will render a company liable, because such injuries are clearly preventable within the limits of reasonable care and expense.

It will readily be seen, from what has been said, that the questions which arise under our subject, are largely questions of fact as well as of law, and that the amount which a railway company will have to pay in damages in such cases will depend to a considerable extent upon the degree of care, intelligence and foresight exercised by those in charge of its mechanical department.

In many states this principle has been to a certain extent defined by specific legal obligation in the shape of statutes—as for instance, by a law requiring the use of stoves in which the fire will be automatically extinguished in case of fire. Such statutes do not increase the common law liability, but reduce the question of fact to a simple issue.

The subject of injuries to employes is upon an entirely different basis from those which we have thus far considered. The employe

is supposed to understand all the ordinary risks of his employment and to accept them. The employer is supposed to furnish good machinery and improved devices, but is not liable for injuries resulting from defects which were obvious to the employe. If the employe notifies the company of such defects and they are not remedied, it is his duty after a reasonable time to leave the employment. But if he is injured by some defect which is not obvious to him, and which the company should have known and remedied, he can recover. Except where otherwise laid down by statute, the employer is not responsible for an injury to an employe resulting from the negligence of a fellow employe. Questions as to who are fellow employes, and many others involved in these relations, have called forth numerous decisions.

But of late it has become quite general for railway companies to require employes to assume all risk, by the contract of employment. The law permits this except in the case of criminal neglect—a thing which is hard to prove. This virtually puts an end to damage suits on the part of employes, and has removed one principal inducement for a railway company to adopt certain classes of improvements. Employes generally are willing to assume the risk, and do not make any decided demand for the adoption of safety appliances. Their reckless disposition has been frequently illustrated. In one state where many brakemen had been killed by overhead bridges, a law was passed requiring the suspension of hanging straps across the road near the bridges, which gave warning to the brakeman by a slight blow. The brakemen began very soon to be annoyed by them and to cut them off, and it was actually found necessary to protect them by making it a crime to destroy them. The law must sometimes step in to protect the improvident and reckless from themselves. Acting upon this principle, the legislatures of several states have lately passed laws looking to preservation of life and limb, by requiring railway companies to adopt automatic couplers. State railroad commissioners are also making investigations with a view to urging still further legislation of a similar character. Whether the desired end can be attained or even hastened in this manner may be a matter of doubt. But there can be no doubt that it is due to an existing public sentiment, and that the tendency will continue and increase. It can not be successfully resisted and opposition

will only intensify it. Railway officials can only successfully meet it by such enlightened action as shall make it superfluous and altogether unnecessary. The mechanical officers of railways have been engaged in this work of improvement for years, with manifestly great results in certain directions. To a certain extent they have been hindered and embarrassed by the lack of co-operation on the part of those superiors, whom financial considerations are the only things which can influence. The requirements of the law may make themselves felt by boards of directors who are not inclined to listen to the arguments of those in charge of their mechanical departments. It may thus prove that properly directed legislative action will overcome existing obstacles and really give impetus to mechanical improvement, by clearing the way. If this be true it is the part of wisdom not to antagonize the action of our legislators, but to endeavor to direct it into proper channels, and to place in their hands the most complete and reliable information on the topics which they are investigating.

On motion of Mr. Sprague, seconded by Mr. Briggs, the paper was received and ordered printed in the minutes of the Association.

MR. SPRAGUE—There is a paper which was prepared at my suggestion by Mr. John B. Lawson, to read before this Association on boiler explosion and I suggest that he be allowed to read it now.

MR. CHAPMAN—As there are some gentlemen present who wish to sign the constitution and become members, I move that a recess of five minutes be taken for that purpose. Then they will be entitled to take part in our proceedings.

MR. SPRAGUE—I second that motion.

Carried.

RECESS.

THE PRESIDENT—Gentlemen will please come to order.

MR. SETCHEL—I have the pleasure of announcing that we have received at this meeting 20 new members. I have on my desk the following application from John A Coleman for associate membership.

On motion of Mr. Sprague, seconded by M. Chapman, the application was referred to the proper committee.

On motion of Mr. Sprague, seconded by Mr. Setchel, Mr. Lawson was allowed to read his paper.

MR. LAUDER—I move that the paper be laid upon the table. I make this motion for the reason that there are some peculiar ideas advanced in that paper that I don't know that this Association cares to endorse.

It looks to me as if that might be something in the way of an advertising dodge, and until that is made clear to me I shall oppose putting it in our annual report.

MR. SHAVER—I second that motion.

MR. SPRAGUE—I am aware that Mr. Lawson who prepared and read that paper is the patentee of a boiler that involves the principle advocated, but this paper was prepared by request of our Association. He has proved his theory in the city of Pittsburg that a boiler could not be exploded by ordinary means, and that it could be exploded according to his theory, I am free to say that I have known of explosions that I could not account for, and as we are groping in the dark it seems to me that every theory of this kind, whether correct or not, opens our ideas and gives us a chance to investigate. I therefore see no reason why it should not be incorporated in the report of our proceedings.

THE PRESIDENT—Do you move that as an amendment?

MR. SPRAGUE—I thought I was speaking to Mr. Lauder's motion.

MR. CHAPMAN—I would like to amend that motion of Mr. Lauder by referring that paper to the Supervisory Committee and let them take action upon it as to whether it shall be published or not.

MR. LAUDER—My idea was if it was placed upon the table we could take it up at any time.

MR. SPRAGUE—I hope the members will vote against this amendment

MR. LAUDER—There is no amendment as I understand it. There is simply my motion before the Convention.

MR. SPRAGUE—I am speaking upon your motion to lay it upon the table. I hope members will vote that motion down. As I have said, the paper was prepared at my request and after consultation with our Secretary, whom I supposed was as conversant as any one with the usage in such matters, and Mr. Lawson was encouraged to prepare the paper for our Association. It therefore seems to me that it is only courteous to incorporate it in our proceedings. The theory that he advances is certainly interesting, and to me I admit it is instructive. The fact that he is the patentee of that boiler it seems to me has nothing to do with the principle. He got the principle before he got the patent. Certainly I shall never again have the face to ask any body to prepare a paper if it is not to go into our proceedings.

MR. SETCHEL—I would say in regard to this matter that the subject was one of interest and the manner in which it came before the Association would entitle it to some consideration. Mr. Sprague wrote me, asking if a communication upon the subject of boiler explosions would be received by the Association, and I did not hesitate to reply that I thought the members would be glad to have a paper upon that subject. Of course that does not bind the Association to publish it in our pro-

ceedings, because in doing so we might agree to publish things we could not endorse or be at the expense of paying for, and I think if it is disposed of in the way suggested by my friend Lauder it can be taken up at any time. I think it very wise to examine communications and not endorse anything as an Association that would tend to antagonize those who might be opposed to what are called pet theories, either as a patent or as a theory simply.

MR. BLACKWELL—Is a motion to lay upon the table debatable?

THE PRESIDENT—I believe it is not.

MR. BLACKWELL—Then it seems to me that this discussion is out of order.

MR. JOHANN—I hope the member will not insist upon his point of order, though I acknowledge that it is well taken. If that motion is put now without any proper explanation it will be voted upon without a proper understanding by the members. I think that we should encourage any one to present papers to this Association which have any pertinency to our business, and unless we treat those papers with some degree of courtesy we can not expect persons to present papers to us for our information. The question o boiler explosions is certainly a very important and serious one and we should have all the information we can possibly get upon it. My idea about presenting papers is that all papers to be read before this Association should be handed in and a committee pass upon them before they are presented at all; but after a paper has been read, I think it is no more than common courtesy that it should have consideration. I could not hear the whole of that paper as it was read, but if it is published I propose to read it. We do not commit ourselves to any theory advanced in that paper. It is simply read for the information of the Association, and if you please, you can put at the head of it the words, "This Association is not responsible for anything contained in this paper." Possibly at the next meeting, if it is published, some member may come in with new ideas about the subject of boiler explosions. Therefore, my idea would be, to receive the paper with thanks to the gentleman for preparing and reading it, and then publish it in our proceedings.

MR. SPRAGUE—I wish to say one word further. What we learn in that paper, if we learn anything, is the theory of boiler explosions. A man is not obliged to use Mr. Lawson's patent to obviate that. If he can apply any other process to obviate explosions in view of that theory he has a right to do it. We are not endorsing his patent at all.

The question was then put upon the motion to lay the paper of Mr. Lawson on the table.

The result of the ayes and noes being in doubt, a division was called for, whereupon the paper was tabled by a vote of 31 to 22.

THE PRESIDENT—Discussion on the Boiler Committee's report is now in order.

MR. JOHANN—As chairman of the Boiler Committee, I wish to make a few remarks in opening the subject. The report of the Committee for this year presents simply a review of all the matter that has been published heretofore. The subject of boiler construction and improvements has been gone over so much, that the Committee was at a loss to know just what to take up for this year, and therefore they came to the conclusion simply to make a review, which has been read to you, and will, I presume, be presented to you now in detail, section by section, and, speaking for the Committee, I wish to say that that is simply their idea of the various subjects that have been presented, and it is now for the members to take hold of it, discuss it, and go for it in any way they see fit.

MR. SETCHEL—The first subject contained in the report is the use of steel. Is it the best material to use for boilers and fire-boxes?

MR. SPRAGUE—I am ready to endorse the use of steel for boilers and fire-boxes, but I am not prepared to endorse steel rivets. I have not had very great experience with steel rivets, but from what I have had, I must say, that they do not give me as much satisfaction as iron.

MR. SETCHEL—If members will confine themselves to the subject as announced, it will help the Secretary very much in compiling his report. The subject of steel rivets will come up further on. The members who read the St. Louis Register will recognize the fact that a warfare is being waged by that paper against the use of steel. There are many master mechanics who believe that iron will give as good results. I think it should be ascertained by this Association whether steel is being used as successfully, as heretofore or not.

MR. SWANSTON—I have not discarded steel. We are using steel and nothing else. I asked the question yesterday as to whether some of the members had not discarded steel and gone back to iron.

MR. SMITH—I abandoned the use of steel about five years ago, and since then have been using iron exclusively. I have never had any trouble with iron, while I have had a great deal of trouble with steel. I have never seen a failure of any kind with iron fire-boxes, while I am quite sure I never used a steel fire-box two years without discovering a serious defect.

THE PRESIDENT—What fuel do you burn?

MR. SMITH—Soft coal. I would also say that we use the water of the Mississippi river, which holds a large amount of carbonate of lime in solution. That has a very deleterious effect on the steel. I would also say that we imported one fire-box from England. We had two which were furnished by the Baldwin Locomotive Works. The iron was of Coachville. Several others were made of Tennessee iron.

MR. BLACKWELL—Will Mr. Smith state what brands of iron he has been trying and found so successful?

MR. SWANSTON—I would like to know also how extensively this has been tr ed.

MR. SMITH—I think there are about six of them now—engines which have been under severe service, running night and day. It is seldom that we have over eight to ten hours to wash out the boiler. In regard to the brand of iron, I cannot give the name of the manufacturer of the Baldwin iron. I only know that it came from Coachville, Pennsylvania. The English iron was Lowmoore.

MR. BLACKWELL—What was the greatest mileage obtained with an iron fire-box?

MR. SMITH—This was under the St. Louis Bridge Company, and we kept no mileage.

MR. BLACKWELL—What kind of service would that probably be equivalent to?

MR. SMITH—I presume you would call it switching. It was transferring trains across the Mississippi river to St. Louis. The run was about four miles.

MR. SWANSTON—These were Baldwin Engines, and all had steel fire-boxes when they went there?

MR. SMITH—Yes, sir.

MR. SWANSTON—How long did they last?

MR. SMITH—There was none of them but what developed defects inside of three years.

MR. BLACKWELL—What make of steel did you find so very unsatisfactory?

MR. SMITH—I do not care about naming the steel. I would say though, that I was informed by the Baldwin people, that the Norfolk & Western Road also had trouble with steel.

MR. BLACKWELL—We had a great deal of trouble with iron as well as steel fire-boxes. I say this as a former representative of the Norfolk & Western. I tried the Lowmoore and the Houston brand of iron in the hope that it would prove more satisfactory than the steel, but I am sorry to say that the results of trials with iron were entirely unsatisfactory. A few engines built by the Baldwin Company for the Norfolk & Western Road were supplied with Lowmoore fire-boxes, and an equal number with Houston iron, and nine engines with Otis steel fire-boxes. So far—and it is a matter of about two years' service now—we have had no trouble with the Otis steel. Four iron fire-boxes have given out, two of Lowmoore, and two of Houston have given out, and they will have to be renewed within a month or two. No trouble is experienced with Otis steel, providing that samples from the plates are examined, and found to come within our specification.

MR. SETCHEL—Twelve or thirteen years ago, the Ohio & Mississippi people, that I have had the honor of representing for the past three years, bought forty engines from the Baldwin Works and ten from the Grant Works, and up to two years ago none of those fire-boxes had been renewed, and they were all made of steel, and the service those engines have performed has been, I suppose, as hard as any road in the country; they averaged a monthly mileage of from 4,500 to 5,000 miles. It seems to me that a material, to give such results, must be very good for fire-boxes. In regard to the service of the engines of which Mr. Smith speaks, he must pardon me if I state that such service is nothing compared with the service of engines on the road. We can take an engine that will hardly hold water running a train out out on the road, and put them at the service of which Mr. Smith speaks, using the Mississippi water, and run them without any trouble whatever. While connected with the Miami Road, where I was located about twenty years, we found that we could take engines that would fail entirely using hard water upon our Springfield Division, and bring them to Cincinnati and use the Ohio river water, and they would not only tighten up, but the water would take off the old scales, and we could use the fire-boxes whether made of iron or steel any length of time. You could patch the fire-boxes and run them without any trouble at all. I am unable to see why any kind of material in fire-boxes, using the Mississippi water, should give out, unless on account of being mud-burned, or something of that kind. I think it has been the experience of our members that where they could use any of our river waters, it made very little difference what kind of material the fire-boxes were made of. That has been the expression of members for the past fifteen years that I have been connected with this Association. With such an experience as has been presented by the reports of this Association, it seems that if there were any great failure of steel in the country there would be a representation here to day that would be able to state it, and I think if we have any members here that have such information, and go away without stating it, they make a mistake and do injustice to the Association. The country looks to us for this information. They are constantly writing to this Association from New Zealand, from India, and from all over the world, to know what we are doing in regard to steel fire-boxes, what we are doing for smoke-stacks, for the prevention of throwing sparks, etc. They say "Send us out your reports, we want them," and we should not send out any false impressions! We should give correct information, something that we will be able to stand by.

MR. BLACKWELL—I quite agree with Mr. Setchel in regard to the service of the engine, whether the results are disastrous or otherwise. I may say that one of the engines with the worst cracked fire-box that I

referred to just now, is now engaged at switching service, and doing very satisfactorily, and may continue to do so, if they choose, for years, without trouble. It is when an engine is hard at work, pressing the fire-box for the utmost result, and consequently getting an excessively high heat, that the ill effects are produced. As long as an engine with a cracked fire-box is doing such light work as switching service, of course the ill effect already there is not increased. As regards iron fire-boxes, I may say that another brand of iron was in use on the Norfolk & Western Road when I went there. I found that we had to abandon it, as it acted exactly like some steel. Men accustomed to examine cracked steel fire-boxes were prepared to state that they were made of steel. Instead of that they were iron. They gave us very unsatisfactory results, and after running from four to eighteen months, they had to be renewed.

MR. SHAVER—When we first commenced to use steel we had some little trouble with fire-boxes cracking, but for the last twelve years I have not known of any cracked sheets. I have not known of one giving out unless there was some good reason for it. For myself, I do not want any iron boxes.

MR. TURREFF—I don't think I shall go back to iron again. I have had such good results with steel that I shall continue to use it.

MR. WOODCOCK—After an experience of some fifteen years in the use of steel for fire-boxes and boilers, I am prepared to endorse it as a good material. While we have had exceptional cases of failure, yet the majority overcomes them. Take a fire-box that has made over 4,000 miles a month—which is exceptional mileage—and it speaks well for the steel. While probably that is an extreme case, yet, as a whole, in the coal that we burn, which is very severe, and particularly in the service that we run our locomotives—high speed passenger service—we have had very exceptional results, I think. We have several engines that have made over one hundred thousand miles, and the fire-boxes, to all appearances, can run perhaps 75,000 miles more. We have some locomotives that have been in use since 1869, with steel fire-boxes, and the crown sheets are still in them. The side sheets that we have usually used have been a quarter of an inch thick, and we have had very good results. It has been a question sometimes in my mind as to the quality of the steel, whether it should be crucible steel or something else. We are using both kinds, and I can say we have no desire as yet to go back to iron. We have a number of boilers running with iron which have proved very satisfactory; but one thing in the use of steel that overcomes the use of iron is, we do not find any blisters; the material is perfectly homogeneous. The most trouble we

have is occasional cracks. We do not consider steel a failure by any means, and we propose to continue its use.

MR. MEEHAN—We have 160 engines, equipped with steel fire-boxes. The greater proportion of them, I believe, are of Otis steel. We have also eight or ten equipped with iron, and out of the ten there were eight that were blistered, and we had to take the boxes out before they were much worn.

THE PRESIDENT—When Mr. John Hurley was on this Continent the Pennsylvania people gave him some figures. Taking ninety-one of their engines, they found that the average mileage per engine before the fire-box failed was 219,926 miles. One steel box made a mileage as high as 505,890 miles, and the smallest mileage made by any one engine was as low as 55,860. I think a general average of 209,926 miles is a large mileage.

MR. STEVENS—I would like to inquire what the term "failure of fire-box" means. Was the box entirely worn out, or was it the failure of any part of the box.

THE PRESIDENT—Renewal of fire-box throughout.

MR. STEVENS—That was when the fire-box was completely worn out.

MR. SETCHEL—I think it is generally understood that when a fire-box cracks or fails in any one place, that that practically is a failure of the fire-box, because in burning coal with us it is very hard after a fire-box fractures to keep that box in good running order economically. I think you better take it out, as a rule. When I spoke of the life of the Baldwin engines on the Ohio & Mississippi road, that was what I meant: that the fire-boxes were practically perfect after twelve years' service.

MR. STEVENS—That is just the point I wanted to get out. That fact of having the fire-box all wear out is altogether different from the Lake Shore road's experience. The tube sheets there will run twice as many miles as the side sheets, and it is not infrequent that a crown sheet will not wear out two tube sheets and four side sheets. I think that it is important in getting at this matter that we should not be misleading.

MR. SHAVER—If crown sheets give out much faster, how do you account for that?

MR. STEVENS—The crown sheets will last the longest. There is no trouble with the crown sheets if they are kept clean. The reason why the side sheets wear out quicker is because they get hotter.

THE PRESIDENT—If no more members wish to speak, we will close the discussion on this particular section.

MR. STEVENS—I move that it is the sense of this Convention that steel is the proper material for fire-boxes.

MR. BLACKWELL—I second the motion.

Carried.

MR. SETCHEL—The next subject involved in the report is, "Drilling versus Punching: which is the best and most practicable," I suppose would be the idea. I know in the history of this Association there were a number of years when we first commenced using steel that our best members strongly advocated the drilling of sheets, but I find that almost without any noise being made about it the majority of the members have quietly dropped back and are punching their sheets. While I believe that in England there have been some experiments made, where it would tend to prove that it was better to punch than to drill the sheets - I can not give the particulars of that, but I have read in some of our journals of tests being made to that effect—I think if we have made an error in advocating drilling of sheets exclusively, that we should let it be known and go back. But if we still believe in drilling certain portions, that should also be known—at least let it be understood which is thought by the members of this Association to be the best way.

THE PRESIDENT—I think the English experiments Mr. Setchel refers to, proving that it was stronger to punch than to drill, were some experiments designed to test riveted joints, where it was endeavored to so design the joints that they would not fail by shearing the rivet. In that case, under those conditions, quite a number of the joints showed very much greater resistance to shearing the rivet with a punched hole than with the drilled hole; the reason believed to be that the sharp edge or square edge left by the drilling was more effective as a shearing edge than the somewhat jagged edge left by the punch.

MR. WOODCOCK—I think the matter that has been referred to by our Secretary depends largely upon the quality of the steel. I do not think it is necessary to drill holes in the open hearth steel, but where we use crucible steel I think it would be necessary to drill them. That is our former experience. There are very few, I presume, using crucible steel at the present time, but if we should resort to that I should be inclined to drill the holes. That has been our experience in former years when we were using crucible steel. But the makers of the present open hearth soft steel contend that it is not necessary to drill the holes. For that reason I think we have fallen into the habit of punching the sheets; first, because it saves time and expense, and of course that is quite an item.

MR. SINCLAIR—In regard to this matter I would draw the attention of our members to certain experiments that were made last year at the works of Hoopes & Townsend, in Philadelphia. They drilled certain sheets and punched others, of precisely the same quality and the same

size, and they found that there was a considerably greater tensile strain required to fracture the punched plate than there was to fracture the drilled plate. Now, in that case, the reason which our President gives for the punched plate probably standing the greater strain would not hold, because the sheets were taken singly. It was not a shearing strain that was tried. It was merely the tensile strain of the sheet after the holes had been drilled. These experiments seem to me very conclusive in that matter. It was, however, soft steel that was used and some iron plates, if I am not greatly mistaken. I think these experiments will be of great interest to all of you if you were to look up the accounts of them.

MR. LAUDER—I suppose 99 per cent. of the members of this Association will continue to punch their plates no matter what we may say here, and I think the discussion on this point better be closed, and I make a motion to that effect.

MR. BLACK—I second the motion.

Carried.

THE PRESIDENT—It is now 12 o'clock, and we will take a recess until 3 o'clock, for the purpose of going to the Executive Mansion to call on the President.

AFTER RECESS.

The President called the Convention to order at 3 P. M.

THE PRESIDENT—The Secretary will please read the head of the next section in the Boiler Committee's Report.

MR. SETCHEL—The next point considered by the Committee is, "Rivets, involving the kind of rivets and the distance apart."

MR. SPRAGUE—I have made some experiments with steel rivets, testing their comparative strength with iron rivets, and I am not favorably impressed with them. I think they are more apt to fly than iron; but still my experience with them has been very limited.

THE PRESIDENT—Was the steel used in the rivet of equal quality with that used in the boiler plate?

MR. SPRAGUE—They were simply plate made, I suppose, as near the tenacity of iron, being composed of steel, as they could be made. In testing we found they were much more apt to fly, and I had occasion to go over some boilers that had been made with steel rivets a short time ago, and several of the heads had come off and we had to put in screw plugs because they were in places where they could not be re-riveted after the boiler was put together.

MR. SMITH—I would like to ask how the riveting is done of the steel rivets, whether by compression or hammering.

MR. SPRAGUE—We do ours with a mechanical sett with a parallel relieving hole in the bottom. We drive the rivet down perpendicular

with two heavy hammers weighing five or six pounds apiece. Then we put on the sett and set it down. Then we take off the sett and hit it a blow or two. Any surplus of the sett goes up in the top of the comb so as to allow it to drop right down to the head of the sheet. I have been using that system for some time. It is claimed to be a patent—though I don't know whether it is or not—but we have paid a royalty on it. I like it very much, both on the amount of work we can do and in quality.

MR. BLACK—I move that subject be closed.

MR. BLACKWELL—I second the motion.

Carried.

MR. SETCHEL—The next point made by the Committee is in regard to the desirability of power riveting.

MR. SPRAGUE—With regard to riveting I would say that our establishment is small, and our boilers are small, and many of the parts could not be got at with power riveting to advantage, and since I have got into this hand riveting by sett I have not been so anxious to get a power riveter. We can drive 325 rivets in ten hours, and it makes it so much cheaper that we have rather abandoned power riveting.

MR. LAUDER—I apprehend that railroads in general are not able, perhaps, in fact the amount of work done would not warrant them in putting in appliances to drive rivets by power, and I think the question of how to drive them by hand would interest us more. Some roads can afford to have a power riveter. The work done on their roads is so heavy that they can afford to put in an appliance of this kind. I think, however, most of the roads drive by hand. Therefore I think the discussion better take the form of whether it is better to drive rivets in the old fashioned way by hammers, or to drive with a sett. I find we can drive with a sett about three rivets to one in the old fashioned way, and I think that is the best way of hand riveting that has ever been brought to my notice.

THE PRESIDENT—If members do not wish to discuss this matter any further, we will pass to the next section.

MR. SETCHEL—The next point made by the Committee is, "Caulking: The bad way in which caulking is usually done, and the better way of caulking with approved tools as has been indicated on the board."

THE PRESIDENT—This is the old fashioned style (illustrating by a drawing on the black board). This is the tool of which the good work was shown in the Centennial Exhibition (indicating the new). This tool puts no strain on the rivet or the joint, and with hydraulic riveting no strain is actually required (indicating).

MR. SPRAGUE—I have been using the new form of caulking there for some time, and I like it very much. I think that all sheets should be

beveled for caulking before they are put together. We have a shear in our works where we shear all the sheets with the exception of a few angular sections that we cannot get at, and the concave circles are all sheared to a bevel before they are put together and caulked with that second, or No. 2, tool.

MR. SETCHEL—There is a point somewhat connected with the one we have passed over and this, in which I was considerably interested. It was stated by the Committee that by making the pitch a little larger and increasing the size of the rivets and using hydraulic riveters, that boilers were made tight without caulking, even at so high a pressure as 160 pounds. If we are able with that method of riveting, and spacing our rivets properly and using steel rivets, we can avoid the necessity of any caulking, why it certainly would be a great advantage; but I judge from the fact that the matter is not taken hold of by members that the old system, as Mr. Lauder has stated—or rather the system that has recently been before this Convention, that of button sett riveting,—is the kind generally practiced by members. That has been my practice, but I find it necessary to caulk boilers, and to be sure that we get a good job we caulk inside and out, and while I think that button sett riveting is the best method, if any other system would prevent the necessity of caulking it might be worth while to inquire into it. I think these things should not be passed over without thinking of the suggestions that the Committee make, and try and improve by them.

THE PRESIDENT—I might explain to the members of the Convention that this statement as to the high pressures that can be carried by boilers without weakening the joints under hydraulic pressure, is not made by persons interested in the sale of hydraulic lifting machinery. The Committee quote the statement of L. E. Fletcher, Inspector of perhaps the largest Boiler Insurance Company in the world—a man who would not be likely to make a misstatement or encourage the manufacture of boilers that were at all weak or faulty in construction.

MR. SPRAGUE—I suppose there is nothing utterly impossible, but i seems to me very near impossible to put the shell of the boiler together so tight that it would not require a little calking. I think the grand secret of a good boiler is to have it tightly fitted together. Instead of having the bearing all on the edge and have but little lap, we always try to put our boilers together tight, but still we cannot put them together so that they do not want calking.

THE PRESIDENT—We will pass to the next section of the report.

MR. SETCHEL—The next point treated of by the committee is, "Crown Stays: which is the best and proper method of securing crown sheets?" —and closing with a recommendation to use screwed stays from the outside sheet through the crown, and riveted over.

MR. SPRAGUE—I have built several boilers in that way, and I am very favorably impressed with that kind of stays. The majority of our boilers we do not build in that way, because we have to put the dome over the fire-box, but where the dome can be got away from the fire-box I think that system of staying is the best.

MR. WHITNEY—I would like to inquire if anybody who has used boilers stayed in this manner has had any trouble with their tube sheets. I have been informed that there has been some trouble with the tube sheets, so that it is difficult to keep the tubes tight, and it has been attributed to this method of staying; the reason that has been given being that when the fire-box became heated it thrust upward and the outer shell resisted the thrust and crippled the tube sheets. And to get over that difficulty the stays have been put in, I understand, so that they wont stay really when the boiler is under pressure, but will thrust up.

MR. BLACKWELL—I may say that on the Norfolk & Western and Shenandoah Valley Railroad, we had some 48 or 50 stayed in the manner described, viz.: by direct stays from the crown through to the outside shell, and also stayed horizontally. We had no trouble whatever in the respect referred to by Mr. Whitney.

THE PRESIDENT—The Secretary will please read the next section.

MR. SETCHEL—The next paragraph is in regard to the proper kind of flues, the committee, I believe, advocating steel flues for the body, set with copper ferrule brazed to the flue.

MR. SPRAGUE—I would like to know somebody's reason for brazing thimbles on to a flue. I have never done it and have never seen any reason for doing it. When I first commenced to use thimbles it was the general practice to braze them on, but it did not look to me as if there was any advantage in it, and I put them on loose and have always done so since. The tendency would be to harden the metal, and that would be an objection and slight additional labor, and I cannot see where the advantage is.

MR. SETCHEL—In reply to Mr. Sprague I would say that the more joints you have to keep tight in a fire-box or flue, of course the more trouble you have in keeping them tight. By brazing the thimble on, you do away with the very worst joint you have to keep tight, which is the copper against the rough flue. That being made tight, the copper is easily adjusted to the small turned surface of the flue sheet. That is my theory.

MR. SPRAGUE—I don't understand that as a rule they take any particular pains to make them tight. If they are not tight the compressing of the flue to get this bearing on the sheet would have to compress that hard brazing, and the tendency would also be to make it loose and

make the opening again the same as if it was not brazed on. That would be my judgment of the matter.

MR. SWANSTON—We did put in all our flues in the manner Mr. Sprague speaks of. But we made experiments by putting one-half a set in with and one-half without brazing, and found quite an advantage in brazing, and we have continued it ever since, and it has been demonstrated that we can keep flues tight a great deal longer with brazing than without.

THE PRESIDENT—The experience of one member is that when we did not braze, the tubes expanded differently from his boiler, and played backwards and forwards in the ferrule; the ultimate result being that with good beading on the point of his tubes, he still had leakage at that point, and he got over it by brazing.

MR. SPRAGUE—Well, experience, of course, will test the thing. I know a master mechanic who told us that he had no trouble with our flues, and that he did have trouble with the flues of other manufacturers which were brazed on.

MR. LAUDER—I suppose the practice would largely depend on the section of the country where the engines were used. In places where the water is good I think either practice is well enough, but where the water is impregnated strongly with lime it probably allows the tube to become very much hotter than it otherwise would, and the tendency to push through the tube sheet is greater than when pure water is used. I apprehend in the Eastern portion of the country, where the water is good, we would have no trouble with the thimble put on in the usual way, but on the Western roads, where the water is bad, I think they would have to braze it on.

MR. SPRAGUE—I would like to know if there is anybody here using steel flues. That is something I don't know anything about. It seems to me that we ought not to recommend a thing that none of us knows anything about.

MR. SETCHEL—I have used two or three sets of steel flues, and I have had very poor success in keeping them tight until we succeeded in welding on them what we call safe ends, and then we found there was no trouble in running steel flues. They make a very good steaming flue. You can use a thinner flue, and by employing a good safe end you get a better steaming boiler than you do where a thicker iron flue is employed.

MR. SPRAGUE—I would like to ask how those flues were made. I suppose they were welded.

MR. SETCHEL—Seamless drawn tubes?

MR. SPRAGUE—That would obviate any trouble in welding, so far as the flue is concerned, but the way they are progressing now with seam-

less drawn steel tubes, I suppose it would be practical to draw steel flues seamless to any thickness.

MR. WHITNEY—I have used some that were welded in the ordinary way, and we have had no trouble in keeping them tight.

MR. HATSWELL—We use steel flues, and we don't have any trouble in welding them, any more than we have with iron. We weld the iron ends on to the tube, and they set just as tight, and we use them for the fire-box end.

MR. LAUDER—I would like to ask what is meant by a steel tube with a safe end?

MR. SETCHEL—What I mean by a safe end is a piece about six inches long, made of the very best quality of tube iron, and about No. 10 wire gauge in thickness, something extra for the purpose of standing the riveting, and also getting sufficiently large rivet to withstand the action of the fire. A steel tube of the ordinary thickness, when put in the sheet, has so little material to bead over that it will not hold the flue in the sheet. You must have something with more strength to it, and we use what we call a safe end for that purpose.

MR. LAUDER—The object being to get a tube thinner than is possible with iron. I can see, then, readily the advantage of it. I think that is a proper statement of the reasons why the steel tube is recommended in preference to the iron.

MR. SETCHEL—The next subject considered by the committee is, "Heating surface: the difference between the value of the heating surface of the fire box and the flues."

THE PRESIDENT—I think this question could not be discussed unless the convention had the figures contained in the report. The same remark applies to the next section, "On the influence of blast pressure of fuel."

MR. SETCHEL—Passing those two sections, the next is, "Hollow stays: questioning their value." There are several members here who have had quite an experience in using hollow stays of one-eighth inch up to two inches.

MR. SWANSTON—We use a large two inch tube, and put about seven or eight inside, according to the size of the fire-box. We think they are a very good thing, and we get along very well with them. There is no trouble in keeping them tight that I see.

MR. SETCHEL—I would like to ask Mr. Swanston how his engine steamed?

MR. SWANSTON—We think we get better results with the tubes than without them. I put in the stays for that very purpose.

MR. SETCHEL—I don't like to do quite so much talking, but if nobody else will talk I shall have to. I believe it is not generally contended that

these large tubes put in the side of the fire box increases the steaming capacity of engines, but they are put in for the purpose of doing away with the smoke for passenger service. I believe this was the original design of the Pennsylvania road, but I think it has been the experience of all on the Pennsylvania lines that it does improve the steaming of the engines, and perceptibly decreases the amount of fuel consumed. I know on the Ohio & Mississippi Road, when I commenced putting them in, it created considerable amusement for the boys. They thought the engines were going to be spoiled, but after the engine had been running a short time they all wanted them put in their engines. I would like to hear the experience of any others that have tried them.

MR. HATSWELL—I would like to ask if Mr. Setchel has experienced any difficulty with the flues leaking in using those hollow stays?

MR. SETCHEL—No, sir.

MR. HATSWELL—About two years ago I tried the experiment of using two-inch flues—I did not call them stays—through the back end of the fire-box, right above the deck plate, and it worked very satisfactorily. It aided combustion, and did away with this nuisance of black smoke, and the engine was economical on fuel. Then I put in another row in front, and it worked very well until last winter, when the cold weather came on, when the drawing of that cold air through those large flues caused leakage. I thought I would put a plate over and stop the leaking. I also experimented with a steam jet. I put it in the back, in the side, and in the front, and it did away with the black smoke to a very great extent, but if you run the engine heavy it had no control of it; so that I concluded it was of no benefit. With those large openings, however, we have found a decided benefit in an engine steaming. If you put in five, and sometimes six, of those large tubes in the back end, it aids the engine in steaming. We use that in connection with a brick arch and extended front.

MR. BRIGGS—I have tried the tubes in the side of the fire-box for the purpose of aiding combustion, but I never put them in with a view of staying the boiler in the least, and I understand that this discussion is about hollow stay bolts. I have had considerable experience with hollow stay bolts. They are an advantage in this way: They act simply as a detective by which you can find out a broken stay bolt whenever it occurs. I was bothered considerably by broken stay bolts, and I found that these hollow stay bolts will let me know without fail when one is broken. With regard to the tubes inside of the fire-box to aid combustion, I believe it is an advantage. I have tried them, and would advise the use of them. But with regards to the stay bolts, I think they are only good so far as they act as a detective.

THE PRESIDENT—There is a little confusion as to the meaning o

terms. This section of the report refers to the use of openings in the side, front or back of fire-boxes, admitting air directly into the fire-box, and not permitting the control of the amount of air delivered through those openings, as compared with fire hole door having openings in it, so as to permit free air to go through it, and also permitting you to control the amount or supply of air that you admit into the fire-box above the level of the fire. The point is here: Is it better to have these openings that do not permit of controlling the air supply above the fire, or should you have such a fire hole door as will permit you to admit a large body of air, and also to control the amount of that air?

MR. LAUDER—I believe in admitting air over the fire in any way that will produce the combustion of the gases, and prevent the smoke; but I think it destroys to a certain extent the steaming qualities of the engine. That has been my experience. Wherever air is admitted above the coal, it will, to a certain extent, interfere with the steaming power of the engine, making it consume more fuel.

MR. SWANSTON—That is not our experience with the ordinary tube, placed pretty near the top of the fire, but I think it is our experience wherever the door is left open, and you try to control it by the door. The air is admitted away back from where the action of the draught is felt, and that cold air will blow into the top of the flues, and probably lose steam; but with the tubes in the side of the fire-box we haven't any such result, and especially with a brick arch.

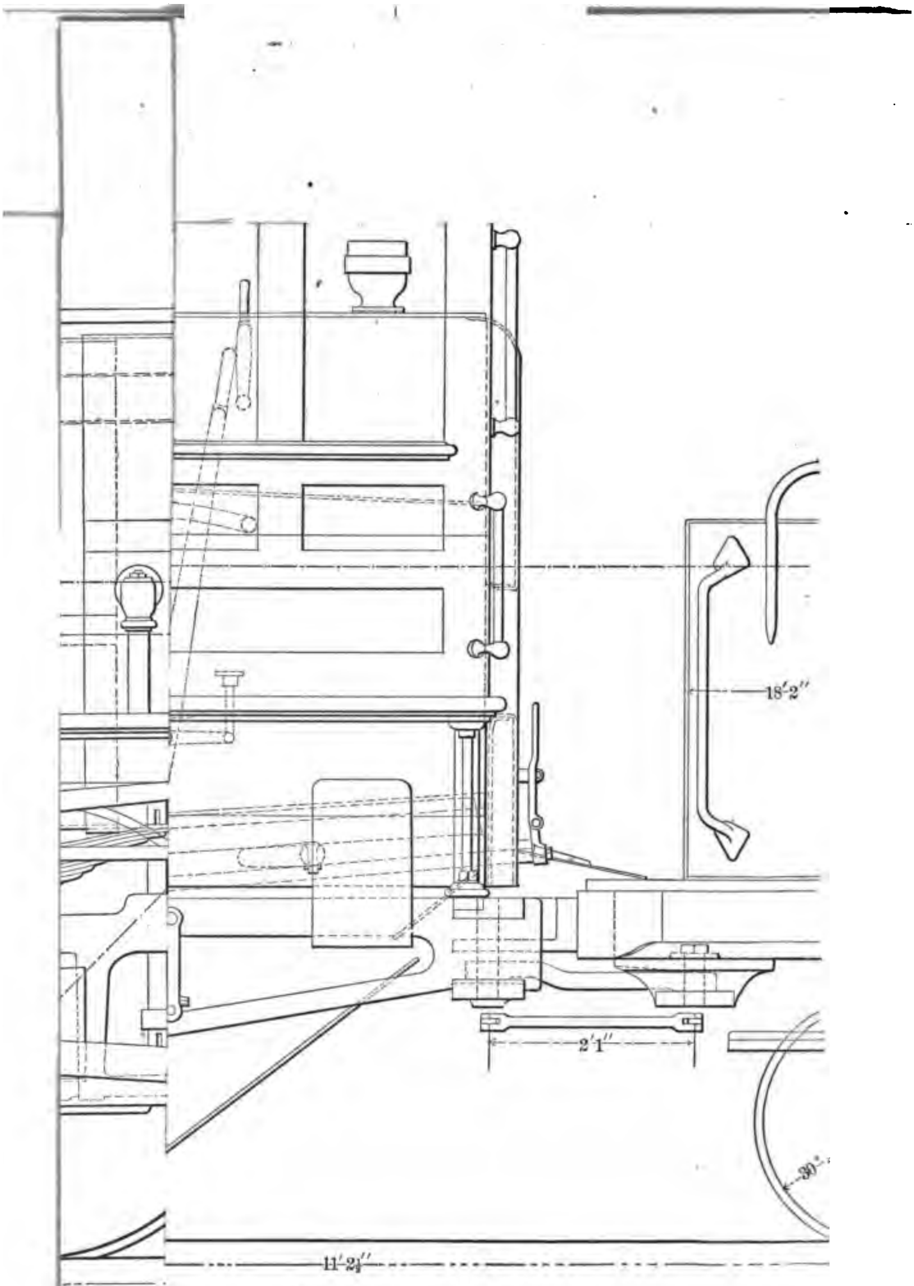
MR. SETCHEL—The next point referred to by the committee is, "Scale: detailing the non-success of any scaling preventatives, and reiterating the opinion which has been very prominently advanced by all the members, that pure water is the best preventative of scale."

MR. SWANSTON—We will all admit that.

MR. SETCHEL—Then we will pass to the next section, which is, "Pitting and furrowing at the joints," which is also in accordance with the sentiment so often expressed by this Association. I believe that constitutes the entire report.

THE PRESIDENT—Having closed the discussion on the Boiler Committee's Report, the natural course would be to take up the next report, but the blue prints not being in position, we will, therefore, take the report of the third committee, which is that on improvement in valve gears.

The report referred to was then read by Mr. Blackwell.



OCOMOTI

REPORT OF COMMITTEE ON IMPROVEMENTS IN LOCOMOTIVE VALVE GEAR.

To the American Railway Master Mechanics' Association:

Your Committee, appointed to report at this meeting on improvements in locomotive valve gear, beg to offer the following as the result of their investigations.

A number of questions bearing on the subject were as usual printed and circulated by your Secretary, and in addition to these your Committee forwarded some to Mechanical Superintendents of European Railways.

About five (5) per cent. of the parties to whom circulars were sent in this country replied, in any way; whereas about eighty (80) per cent. of the circulars sent to Europe were promptly and fully answered.

Judging from the replies, it would seem that apart from those using the Joy gear, Messrs. Mitchell and David Clark, of the Lehigh Valley Railroad, are the only men in the United States who have lately been experimenting with valve motion of a different character to that in general use; but until these experimental gears have been fully tested, it would not be proper to describe them as improvements. The design of the gear used by Mr. Mitchell was furnished by Mr. George S. Strong, of Philadelphia, and as it is understood that a paper describing his and other radial gears will be presented to the Association, no extensive mention will here be made of it.

Mr. David Clark has been good enough to furnish your Committee with blue prints here exhibited, of a 20"x26" ten-wheeled engine fitted with an independent cut-off, combined with link motion; also in tabular shape, a number of indicator diagrams taken from a passenger engine, fitted with similar valve motions and showing its capabilities.

It will be noticed that with this gear, six (6) eccentrics and rods, four (4) rock-shafts, two (2) reverse levers and rods, and two (2) additional valves, valve seats, valve stems and stuffing-boxes are required. This, of course, means considerable extra cost of construction and maintenance, and it yet remains to be proved whether the advantages gained are equivalent to this additiona cost.

PASSENGER LOCOMOTIVE No. 400, L. V. R. R.

Single exhaust nozzle, 5¼ in. diameter, with 3¼ in., central lifting plug to close opening from 21.6 sq. ins. to 13.3 sq. ins.

Nos. 22, 23, and 25, engine run with link motion, throttle being full open at quick speed; too much steam entered to exhaust again through main valve, exhaust nozzle being full open.

NOTE.—Compare with 1, 2, and 24, for slow speed. Compare with 13, 15, and 16, for quick speed, with less steam. Main valve full and cut off.

Two steam ports, each, 16½ in.x1¼ in. wide.

One exhaust port, 16½ in.x2½ in. "

Bridge, 1⅛ in. "

In diagram 26, there was abundant compression to take up momentum of rods, &c.; link at 18 in. being sufficient for steady running.

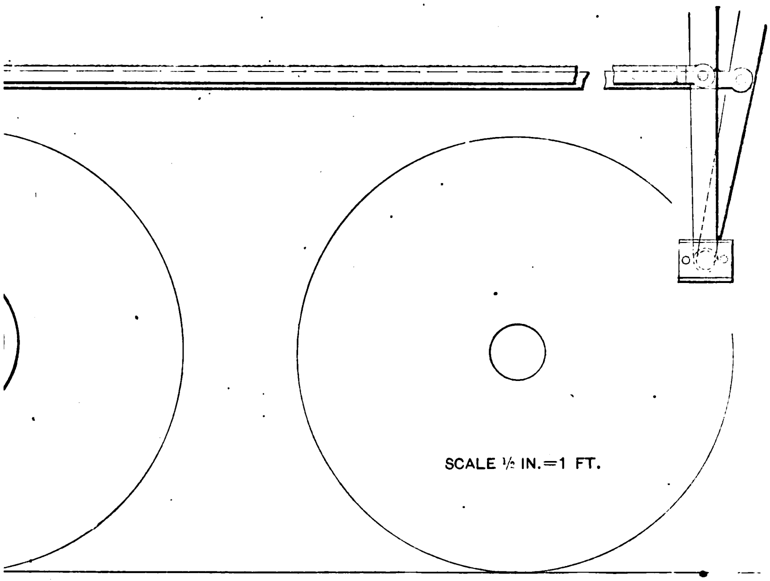
HAZLETON, May 25, 1885.

C. Blackwell, Esq.:

Above find answer to yours of the 20th. I will be pleased to have you ride on an engine with this cut off on. I hardly expect to be at our meeting at Washington. Truly yours,

DAVID CLARK.

Number of Indicator Diagram.	Main Valve Cut Back to	Cut-off Valve Cut Back to	Steam Port Closed When Piston Moves.	Per Minute, Revolutions.	Miles an Hour.
	MAIN VALVE ONLY.				
24	18 in. stroke.	Link Mo on.	18 inches.	Slow.	
25	18 "		18 "	120	24
1	16 "		16 "	Slow.	
23	16 "		16 "	145	29
2	10 "		10 "	Slow.	
22	10 "		10 "	166	33
3	8 "		8 "	Slow.	
21	8 "		8 "	144	29
	CUT-OFF VALVE.				
6		8¼ in. stroke.	8¼ inches.	Slow.	
16		8¼ "	8¼ "	150	30
5		5¾ "	5¾ "	Slow.	
15		5¾ "	5¾ "	150	30
4		4⅝ "	4⅝ "	Slow.	
13		4⅝ "	4⅝ "	144	29


SCALE ½ IN.=1 FT.

Number of Indicator Diagram.	COMBINATION OF CUT-OFF VALVE AND MAIN VALVE.				
	Main Valve Cut Back to	Cut-off Valve Cut Back to	Steam Port Closed When Piston Moves.	Per Minute, Revolutions.	Miles an Hour.
7	16 in. stroke.	$8\frac{1}{4}$ in. stroke.	$11\frac{3}{4}$ inches.	Slow.	
17	16 "	$8\frac{1}{4}$ "	$11\frac{3}{4}$ "	164	33
8	16 "	$5\frac{3}{4}$ "	8 "	Slow.	
18	16 "	$5\frac{3}{4}$ "	8 "	160	32
9	16 "	$4\frac{5}{8}$ "	$6\frac{1}{2}$ "	Slow.	
19	16 "	$4\frac{5}{8}$ "	$6\frac{1}{2}$ "	160	32
10	14 "	$4\frac{5}{8}$ "			
11	12 "	$4\frac{5}{8}$ "			
12	10 "	$4\frac{5}{8}$ "			
26	16 "	5 "	$6\frac{7}{8}$ "	246	50

The above refers to Indicated Diagrams L. V. R. R.

ACTION OF MAIN VALVE OF $20\text{x}22\frac{1}{16}$ PASSENGER LOCOMOTIVE —FULL STROKE.

Steam cut off when piston moves.	Exhaust opens when piston moves.	Steam port opens when piston moves.	Lead.	Steam port opens.
$19\frac{1}{2}$ in.	$21\frac{5}{16}$ in.		$\frac{1}{64}$	$1\frac{1}{4}$ x $\frac{1}{4}$
18	$20\frac{3}{4}$	22 in.	$\frac{3}{32}$	$1\frac{3}{16}$
16	$19\frac{7}{8}$	$21\frac{15}{16}$	$\frac{5}{32}$	$\frac{13}{16}$
14	$19\frac{1}{8}$	$21\frac{13}{16}$	$\frac{11}{64}$	$\frac{5}{8}$
12	$18\frac{1}{8}$	$21\frac{3}{4}$	$\frac{3}{16}$	$\frac{15}{32}$
10	$17\frac{1}{4}$	$21\frac{11}{16}$	$\frac{13}{64}$	$\frac{7}{16}$
8	$15\frac{7}{8}$	$21\frac{5}{8}$	$\frac{7}{32}$	$\frac{11}{32}$

Two steam ports, $16\frac{1}{2}$ in. x $1\frac{1}{4}$ in.
One exhaust port, $16\frac{1}{2}$ in. x $1\frac{1}{4}$ in. Stroke $4\frac{1}{2}$ in.
Bridge, $1\frac{1}{8}$ in. wide.
Outside lap of valve, $\frac{3}{4}$ in.
Inside lap of valve, $\frac{1}{32}$ in.

The above refers to the action of main valve when running with the link motion cut-off out of action.

DAVID CLARK,
Master Mechanic Lehigh Valley R. R.

A valve motion which, on the authority of the Railroad Gazette, January 18, 1884, gave excellent distribution of steam, and was invented by Mr. A. J. Stevens, General Master Mechanic of Central Pacific Railroad, was fitted to the Southern Pacific R. R. engine El Gobunado, building at that time in the Central Pacific shops at Sacramento. As no communication in reference to the performance of this engine has been received by your Committee, it is taken for granted that the valve gear has not been satisfactoy,

and cannot be considered as an improvement. In this, however, they may be mistaken, and are open to correction.

Your Committee understands that the Walschaert gear had been applied to several engines built by the Mason Machine Works, of Taunton, Mass., and upon inquiry are advised by Superintendent Meats that the cost of construction of this valve motion is slightly greater than that of the ordinary link motion, but the cost of maintenance somewhat less on engines of latest design, with large wearing surfaces, and the distribution of steam much evener. The lead with this gear is constant. Your committee is indebted to the Mason Machine Works for Blue Prints here exhibited, showing various modifications of this gear as applied to engines built by this firm.

Mr. Meats' further remarks will be of interest. Your question whether I could consider the so-called Walschaert gear an improvement over the ordinary link motion, seems to admit of both negative and affirmative answers.

Affirmative because of the quicker release and more uniform and diminished depression which it gives; negative, because these advantages are not sufficient in amount or practical importance to outweigh established usage.

For narrow gauge engines, or others in which it is desirable to place the valve motion wholly outside of the frames, the Walschaert gear seems well adapted and in every way preferable to the link motion; but for engines which permit a good and easy arrangement of the latter, it would seem hardly worth while to adopt the former.

Now with regard to the comparative admission, cut-off, release, and compression of the two motions, the Walschaert is more uniform (especially in compression), *i. e.*, if the motion is properly designed; for, so far as my experience goes, much greater care is required in locating the centers of this than that of the ordinary link motion.

While I am sorry to be unable to send you the comparative results in tabular form, I may generalize by saying that although the Walschaert motion is the more speedy, by virtue of its quick release and uniform compression, these advantages are not sufficiently great to justify me in an opinion that it is better for locomotives of all classes.

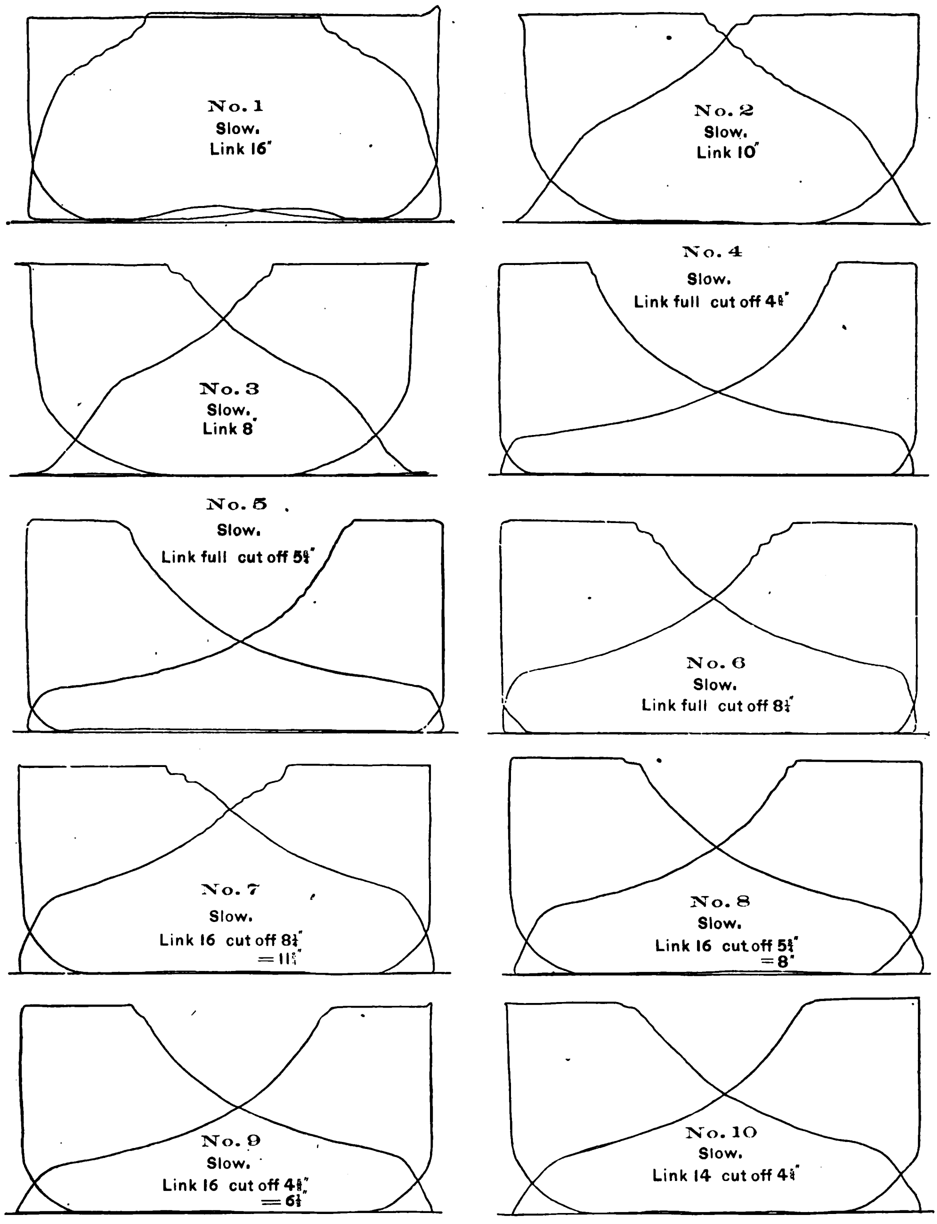
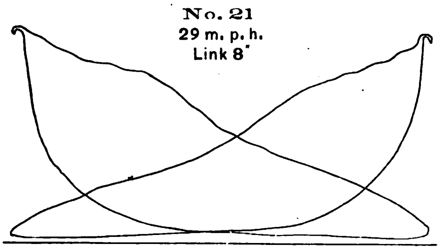
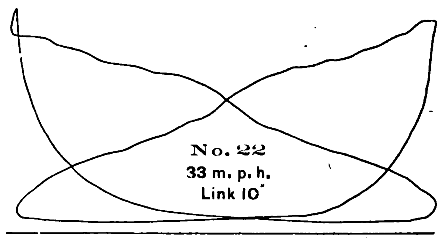
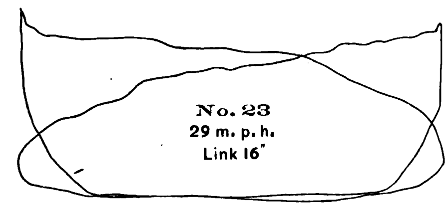
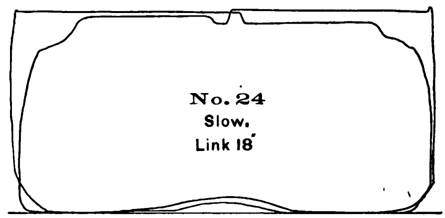

No. 1
Slow.
Link 16"
No. 2
Slow.
Link 10"
No. 3
Slow.
Link 8"
No. 4
Slow.
Link full cut off 4⅝"
No. 5
Slow.
Link full cut off 5¾"
No. 6
Slow.
Link full cut off 8¼"
No. 7
Slow.
Link 16 cut off 8¼"
=11¾"
No. 8
Slow.
Link 16 cut off 5¾"
=8"
No. 9
Slow.
Link 16 cut off 4⅝"
=6½"
No. 10
Slow.
Link 14 cut off 4¾"

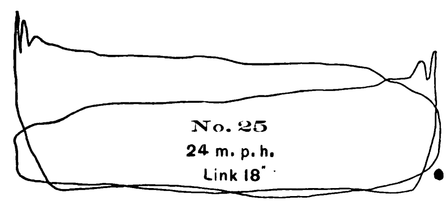
Plate 6—1.

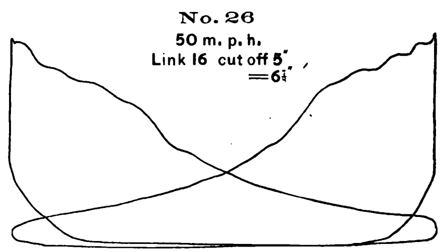


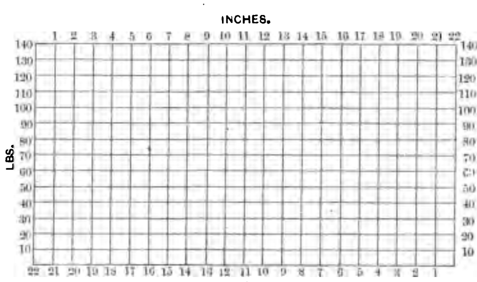












SCALE FOR THE DIAGRAMS.

Plate 6—3.

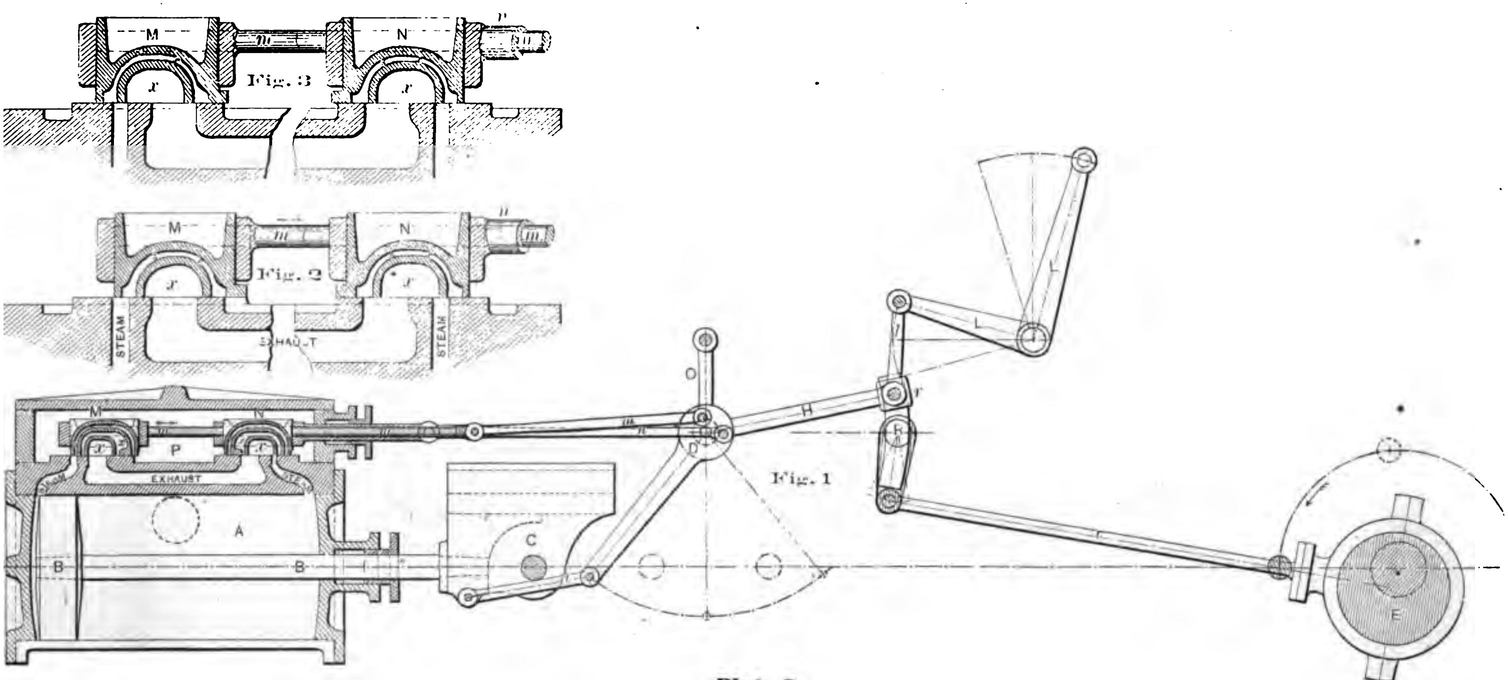
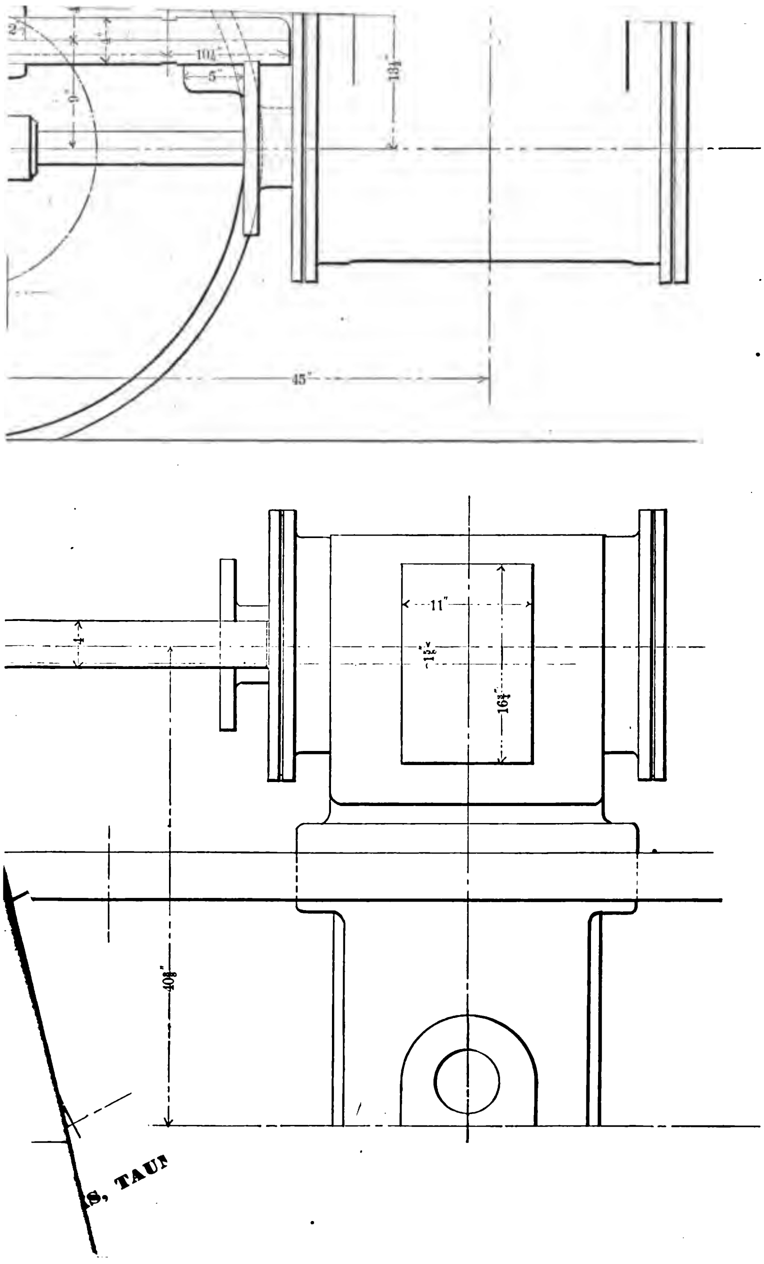
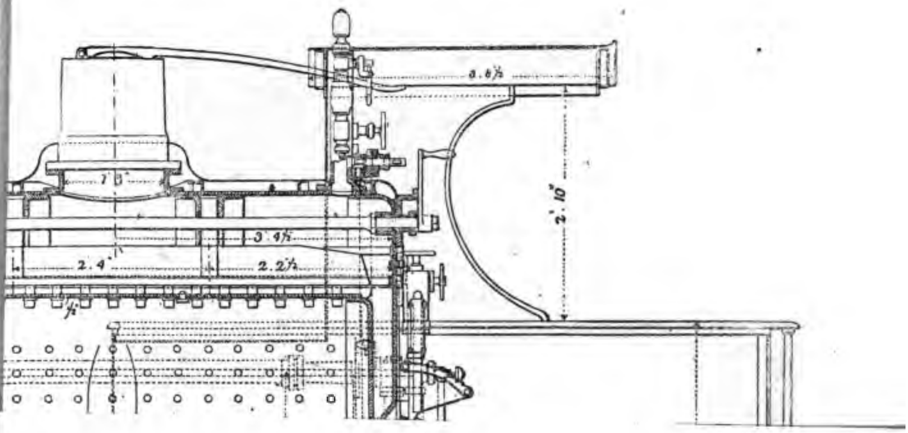


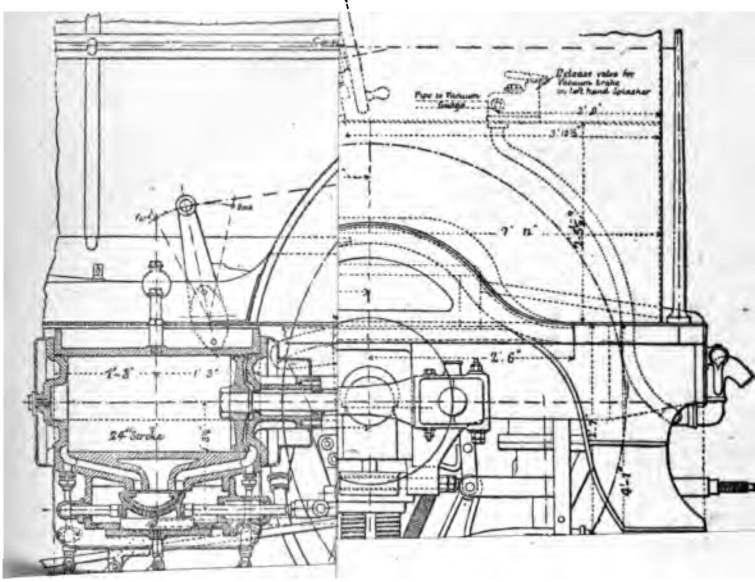
Plate 7.

A. J. STEVENS' VALVE GEAR.

As Fitted to 21 in. by 36 in. Locomotive, Central Pacific R. R.


10¼"
5"
9"
13¼"
45"
11"
16¼"
40⅛"


2'. 10"
3.4½
2.4
2.2½


Release valve for Vacuum brake on left hand Splasher
Pipe to Vacuum Gauge
2' 0"
3' 10½"
2' 6"
1'-8"
1' 3"
24" Stroke
4'-1"

As no mention is made of this gear in replies to the circular, it is taken for granted that the gear is not considered an improvement over the ordinary link motion; or that circulars did not reach those using engines equipped with the Walschaert gear.

The only new valve gear positively reported to your Committee as an improvement on the ordinary link motion, is what is known as the Joy valve gear, and is extensively used in England on marine as well as locomotive engines.

Mr. T. W. Webb, the well-known Locomotive Superintendent of the London and Northwestern Railway, of England, reports that ten of his six-wheeled coupled goods engines, with 18"x24" cylinders and (33) thirty-three Compound Express Passenger engines, were on Feb. 10, 1885, running with this motion.

One of the Good engines had been in service about five (5) years, and the motion had cost very little indeed to keep up.

He has no doubt that when they have made special engines for every part of this motion the same as he has for the eccentrics and links, that they will be able to produce it at a very much less cost. One of the compound express engines he referred to, and as represented by the engraving exhibited, when being indicated with a train of twenty-two cars, and a dynamometer car also attached, developed over one thousand (1000) horse power.

In his replies to the circular he states that he gets good diagrams, but as the Joy gear has been been put on a different class of engines, he could not furnish comparative results of the two gears.

He states that the cost of the gear is less and the reciprocating parts much lighter than in the case of link motion.

He has not had it sufficiently long at work to state the difference in cost of maintenance, but from what he can see so far, the Joy gear is on the right side.

In answer to questions 7, 8, and 9, he states that he considers the Allan straight link motion to be the best description of link motion on account of its giving equal lead. It was patented many years ago by Mr. Alexander Allan, formerly of the Creme Works.

Mr. Worsdell, until lately the Superintendent of the Great Eastern Railway, of England, and formerly of Altoona, states that he has been using on the Great Eastern Railway upon about fifty (50) passenger engines, the Joy valve gear. He says that with

6

it, in the case of inside connected engines, greater facility is given to enlarge the cylinders than with any other motion he is acquainted with.

That the simplicity of the working parts and absence of frictional surfaces, compared with the large surfaces of the eccentric gear is a decided advantage, and that the simplicity of repairs to the joint pins, and the fact of their being less derangement to the valve motion when such joints require repair, is in itself an advantage.

Also that the positions of the working parts of the Joy motion are brought forward, and consequently are directly under the engine driver's observation and reach; every portion of this gear is fully accessible, but with the eccentrics the parts cannot be got at when the engine is running.

In reply to question 2 he cannot say that there is a much better distribution of steam with the Joy gear, as this can be regulated with the eccentrics and links to anything required; but there is this advantage that with Joy's motion the lead is constant, whereas in the ordinary link motion it is variable, and this variable lead he considers a great evil.

He considers that the first cost of construction of each kind of gear is about the same; if any difference it would be in favor of the Joy's motion, because there is nothing in it corresponding to the link fitting, which is the most expensive part. The quadrants or slippers in Joy's motion are turned by the North Eastern Company in large rings, and cut off to the lengths required.

Of the various descriptions of link motion, Mr. Wardsell, like Mr. Webb, considers that the Allan motion is the best, as the lifting motion is only half the other kinds, and requires no balancing, the link being brought down and the valve radius rod brought up to meet the required positions and *vice versa*.

Mr. Wardsell kindly furnished a drawing of the Joy valve gear, as applied by him to the North Eastern Company's engines; also a tracing of the Allan link motion, which is used to a considerable extent in England.

Mr. S. W. Johnson, Locomotive Superintendent of the Midland Railway of England, states that no material improvement in valve gear has come under his notice recently, except Joy's valve gear,

which enables engine builders to construct engines with larger cylinders between frames, to place the cylinders closer together, and to give a larger bearing on crank shaft for single framed engines That when manufactured for a small number of engines, the cost is about the same as for the ordinary gear, but would probably be somewhat less if a large number were made.

He has not had sufficient experience with the new gear to state how its cost of maintenance compares with the link motion.

Mr. William Dean, Locomotive Superintendent of the Great Western Railway of England, states that there is on that road one engine with the Joy gear, but that his experience with it has not been sufficient to enable him to speak of its merits.

Mr. L. B. Paxson, Engineer of Machinery of the Philadelphia & Reading Railway, reports having had the Joy valve gear applied to one of his engines, but that it has been removed in consequence of important patterns for steel castings being destroyed by fire at the Steel Works, and that he could not spare the engine long enough to get up new patterns.

Mr. D. H. Neale, one of the editors of the R. R. Gazette, and probably better informed than any one in this country on the subject of Joy's motion, makes the following statement, in reply to your Committee's circular:

1. Joy's valve gear was in use in several ten (10) wheeled engines on Cape Government Railways, on which line I was acting Locomotive Superintendent.

3. I advised the Chief Locomotive Superintendent to adopt Joy's gear in lieu of the ordinary link motion, as I imagined we should have less trouble from dust, causing wear and seizing in the rubbing parts. Actual practice showed, however, that Joy's motion wore considerably faster, and was more affected by dust than the ordinary link motion. Experience now leads me to believe that valve motion outside the wheels is more exposed to dust than valve motion situated between the frames, and therefore I consider Joy's motion more suitable for inside than for outside connected engines. I also consider that the sliding blocks in Joy's motion should be made as large as the main slide blocks of a locomotive. Unless this is done, the wear, in my experience, is apt to be excessive.

4. In some respects, and under favorable conditions, the Joy gear can be proportioned to give a slightly quicker cut-off than the ordinary link motion, but I regard the constant lead given by the Joy gear as a disadvantage.

5. Can give no positive information on this point. Possibly, with parts of Joy's gear proportioned to wear as well as ordinary link motion, the cost would be about equal.

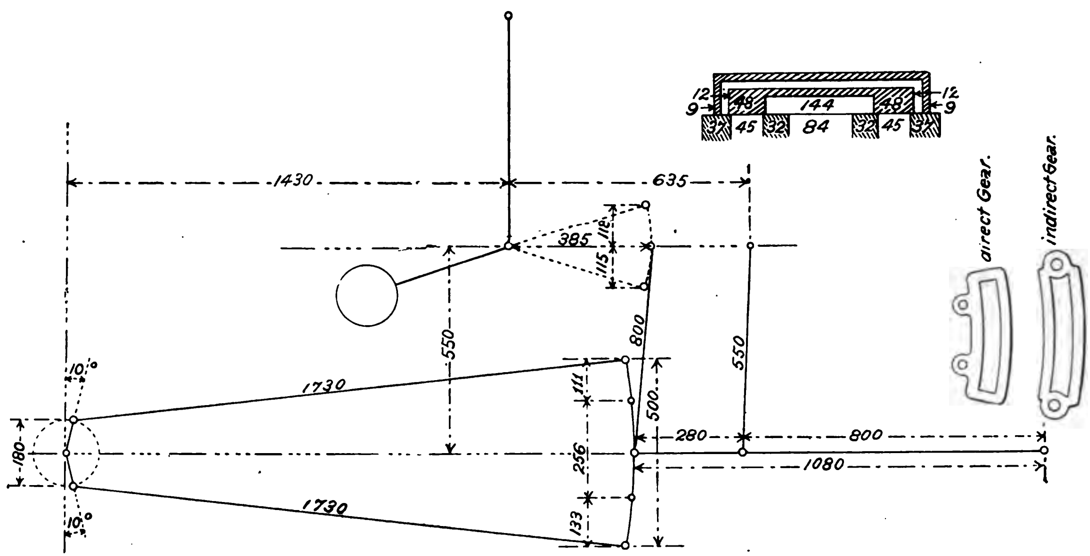
6. Can give no actual figures on this point. The Joy gears on the Cape of Good Hope Railway engines wore so fast that a lead pencil could be placed between the sliding block and guide after six weeks' running, though the engines were built by a first-class maker, and the workmanship was excellent.

Your Committee is indebted to Mr. David Joy for illustrations here exhibited, of engines equipped with his motion, also to Mr. Webb, for photograph of his latest compound engines, also fitted as before described, with the Joy gear.

It is believed that an engine running on the Northern Pacific R. R., and another on the Ontario & Western R. R., are fitted with the Joy valve motion, but as no replies to your Committee's circular have been received from these roads, it is assumed that the engines so equipped have not proved satisfactory.

Mr. Patrick Sterling, of the Great Northern R. R. of England states that some companies have adopted Joy's patent valve gear, but its adoption does not seem to reduce the consumption of fuel, nor do the engines so fitted beat one bit more truly than his own, which are all fitted with the ordinary link motion. He is working all his fast expresses, running over fifty miles an hour, with single wheel drivers eight feet in diameter, and has, therefore, no fear of breaking coupling rods.

Mr. Thomas Urquhart, Locomotive Sup't T. & R. Railway, of South Russia, has had indicator diagrams taken from each type of locomotive on his road, for the purpose of demonstrating the elements which have a more immediate effect upon fuel consumption, and has compiled the whole in a little volume, a copy of which he kindly forwarded to your Committee; but, as the book is printed in Russian, it has not proved so useful as it might have been, had the education of the members of your Committee been a little more comprehensive. He states that the diagrams from the Kess-



Dimensions in Millimetres.

Plate 13.

VALVE GEAR. RUSSIAN RAILWAY. THOMAS URQUHART.

working hard with full throttle she does not get rid of the steam as freely as he would like.

He states that the President of his road thinks she is just the engine for the purpose for which she was intended.

The tabular statement supplied by Mr. Stevens, showing comparative tests of his engine and a Rogers' engine with smaller cylinder, and extending over four months, indicates very conclusively the economy of using the Stevens' gear; the ton mileage for one pound of coal being 11.45 and 8.16 respectively, or over 40 per cent. in favor of the Stevens' engine.

Mr. Stevens says nothing of the cost of maintaining this valve gear as compared with ordinary link motion.

This valve gear is in principle similar to the Hensinger von Waldegg's gear, as described in the treatise on valve gears by Dr. Gustav Zenner, of Zurich, and translated by Professor J. F. Klein, of the Lehigh University, Bethlehem, Pa., and also to the so-called Walschaert gear, before referred to, and applied to several engines by the Mason Machine Works.

The movement of the valve is obtained as follows: A counter-crank or eccentric on one of the driving axles, the eccentricity forming an angle of ninety (90) degrees with crank, is connected by means of a rod to one end of a link turning on a fixed pin, and imparts to the link an oscillatory motion.

The link has a curved slot, in which a slide-block can be raised or lowered by means of a lifting link, so as to produce variable expansion. To the block is jointed a radius rod, which is connected at the other end to a lever, the upper end of which is jointed to the valve stem, and the lower end turns in bearings on the cross-head, or is connected with the cross-head by means of a coupling-rod.

With this gear a constant lead is obtained.

Quoting from Prof. Klein's translation before referred to, he represents Dr. Gustav Zenner's opinion of the H. von Waldegg motion, to be as follows: "Hensinger's construction is without doubt very ingenious, but too complicated; the remark made at the end of the investigation of Gooche's valve gear, viz: that the constant lead is purchased at too high a price, is even more applicable here."

This opinion seems to be confirmed by communications received

from Messrs. John Player, Master Mechanic of the Central Iowa Railway, and R. Derby, Master Mechanic of the South Florida Railroad.

The former states that he has five engines equipped with the so-called Walschaert gear, but thinks that the only advantage over the link motion is the constant lead it produces.

He considers the cost of construction about the same as of the ordinary link gear, but his experience shows that the cost of maintaining it is far greater, the lost motion, after running a short time, being excessive.

He believes the gear capable of being simplified and strengthened, but states that as it is now he would much prefer to use the ordinary link motion.

Mr. Derby states that he has in service three engines fitted with this gear, and so far, has not had any trouble with them, although, like Mr. Player, he considers the gear has too many joints to last long, and does not consider it suitable for locomotive use.

The principal difference between the Stevens' gear, and that applied by the Mason Works, and the H. von Waldegg gear, is in the double valve used in the former.

The two valve stems apparently pass through the same stuffing box, but the drawing does not show clearly the details of this, and means used to make steam tight the hollow valve stem, where the solid stem passes through it.

The two independent valves used by Mr. Stevens, if unbalanced will cause a large amount of valve friction, but of course there is nothing to prevent their being balanced, and these objectionable features removed.

As the diagrams from this motion were all taken at slow speed, the effect of the combination of this gear with the double va ve at high speed cannot be compared with the results given by ordinary link motion, which is unfortunate.

On motion of Mr. Sprague, seconded by Mr. Swanston, the report was received.

MR. BLACKWELL—I think it quite possible the matter of balance valves should have been introduced in this paper, but I was not sure whether it was properly considered as a portion of a report on improvement in valve gears. There is no doubt, however, that the life of the valve mo tion would be much increased by using balance valves, and, in addition some method of reducing the friction on the stuffing boxes.

MR. SETCHEL—There is one question spoken of several times in the report that I would like to ask for my own information, whether the members of the Association generally consider that the increased lead given by the link motion is detrimental to a high speed engine?

MR. SWANSTON—The paper seemed to convey the idea by the majority of authorities quoted that a constant lead was an improvement. Now, I do not think so. I think that the increase lead of the link as you cut off is an improvement. Some years ago, on the Little Miami Railroad, we had a stationary link on which the lead was constant. Now, to get better results on passenger engines, we increase the lead of the backward motion so as to increase it on the forward motion, and we got good results from that.

MR. SETCHEL—Members will take notice that it is spoken of a number of times, and is very often given as a reason for condemning the link motion. If that is so, we ought to know it.

MR. SINCLAIR—As an engineer with considerable experience in running, and also with considerable experience in indicating locomotives, I, as one, wish to say that I am very strongly in favor of increasing the lead as you hook the engine up. It seems to me very certain that if by increasing the lead and getting rid of the steam in the stroke, you get less back pressure at high speeds, and consequently the increase of lead is a great advantage, because, unless you can increase it gradually by hooking up you have got to put a very large lead on to start with. For instance, most of the engines running with the Walschaert motion have to be run with a constant lead of a quarter of an inch to three-eigh hs. Those on the Long Island Railroad have to be run with three-eighths. They tried to run with one-eighth, but found those engines were not so smart as when the lead was increased. Therefore, I think when you get a lead of say one-sixteenth that will do very well, in slow working it comes to be a great advantage to increase the lead by hooking up. It makes it, as it were, automatic, and you gain the advantage of some lead for slow working, and high lead and early release, as it were, for high speed.

MR. LAUDER—I think one of the chief advantages of the link motion is the fact that it does increase the lead as you work the engine short. If the increase of lead is thought to be excessive it is an easy matter to move the eccentric. I am one of the admirers of the link motion. I believe it is what is needed for locomotives, and I yet have to see anything that has the merits, all things considered, that the link motion has. It is a simple, well-designed arrangement as now put on American locomotives. It performs precisely what we want it to perform, and that is to increase the lead as you hook the engine up short. I am well aware that on some classes of engines, where the link radius

is necessarily short, the link motion gives an excessive lead, but that can be gotten over by adding a little machinery—which, of course, is objectionable. In the Mogul engine, for instance, the valve stem has to run back of the forward driving wheel. That necessitates a long valve rod and a short eccentric rod. My practice recently has been to put in an auxiliary rocker to hang the link to. That is, a rocker with only one arm, and hang the link to that arm, and then transfer the motion from that back to the main motion. In that way I get an increase of about twenty inches, and I get a very much better valve motion, both theoretically and practically, than we did by using it in the ordinary way and attaching it to the rocker, as is the usual practice. If there is any objection to this increase of lead you have simply to set the rocker nearer the cylinder and increase the link radius, and I think it will be agreed to such an extent as is desirable.

MR. BLACKWELL—It seems to me that the objection to this increased lead is loss of power to the engine at high speed. It is a question, of course, as to what amount of compression is absolutely necessary to insure the steady running of the engine, and cushioning of the reciprocating parts. From what I learn it has not been fully taken up, but Mr. David Clark, of the Lehigh Valley Railroad, assured me that from his own observation when running on the engine, with his valve motion giving an exceedingly square corner to the diagram, that there appeared to be when running fifty miles an hour quite enough cushioning to prevent unsteady motion of the engine.

MR. LAUDER—There is something, I think, to be gained by compression. I take it that there is no loss by compression unless the compression line, is forced above the initial steam pressure line. If the compression simply brings the pencil up to the line of the steam pressure in the steam chest there can be no loss. If it does not come up to that, you have got a space there to fill when the valve opens. With a well-constructed link motion it will be rarely found to go above the line of the initial pressure of the steam, and in my judgment unless it does go above that there is no loss.

MR. SETCHEL—I have had an experience in running a locomotive with a stationary link where constant lead is given, for a number of years, and then have taken engines on the same train with the link where the increased lead is given with the same number of cars, and I do know, as a fact, that that class of engines will do better work than an engine with a constant lead, and you take the same engine and take off the lead, and then increase it, and it will save your fuel and do better work. About a year ago, in talking with the Master Mechanic of the Reading Railroad about an engine equipped with the Joy valve gear, he gave as a reason that they took the engine off her run, that an engine giving a

constant lead was not able to run those high speed trains steadily. The authorities quoted in our committee's report are very pronounced in asserting that it is highly detrimental to engines, and is almost the only reason for substituting some other motion; but all asserting that they know of nothing better than the link. If this reason does exist, it makes the link better than we think it is. I think an increased lead is of advantage in running a high speed engine.

MR. LAUDER--There is one advantage arising from the use of the Joy valve gear, and it seems to me it is the only one. With the engines of American construction it enables the fire-box to be lengthened from 8 to 12 inches—perhaps 10 inches—longer—without spreading the wheels, more than it is possible to get with the link motion and the eccentric. That must be taken into account, of course, in determining the kind of motion with which to fit our engines.

MR. SETCHEL—I think that statement carries more weight with it in favor of the Joy valve gear than anything else that has been mentioned.

THE PRESIDENT—I notice that the Joy valve gear does not give an equal distribution of steam in the back and front gear. Although I have not seen an engine working with the Joy gear, still, when I have seen drawings showing engines with cylinders about 11 inches in diameter, having motion pins of one and eight-tenths of an inch in diameter, I cannot but think that a great deal of work comes on those pins, if it is absolutely necessary to make the pins of that diameter.

MR. WOODCOCK--Referring to the matter of increased lead of high speed engines, I think we have derived considerable advantage from the use of the Allan valve. That gives us increased lead and works very satisfactorily. Using the plain link motion with the Allan valve has been a decided advantage on high speed engines.

MR. SETCHEL—The point mentioned by Mr. Woodcock is, I think, very important, that with the Allan valve you get double the admission and double the amount of increased lead, and yet it does not appear to be detrimental even with that. I know that we have two engines running, 18 x 24, with the Allan valve, and we find that the increased lead effects them very favorably. We have no difficulty in running those engines with fifteen cars.

MR. BLACKWELL—Before this subject is closed I wish to call attention to a paper which was referred to by the committee on radial valve motion. I was expecting it would be presented, and that was the reason the committee did not go more fully into the radial valve gear subject.

THE PRESIDENT—There is a paper laying on the desk, which has been sent to the Supervisory Committee, giving the history of radial valve gears. It would have been read continuously with the report last read, but we had not the drawings in place, and I thought it was no use dis-

cussing an elaborate paper of that kind without having the drawings to refer to. It will be the first business to-morrow morning, when the author of that paper will be here, as I am informed by a member.

MR. THOMAS—I wanted to speak in regard to the increased lead on valves with a link motion. From the report made here to-day I have noticed that the best results from the Joy motion have been on English engines which have had eight and nine foot drivers, and consequently a slow piston speed; but on the decreased driving wheel that we are using in this country, which consequently gives an increased piston speed, I think the increased lead is required to balance the piston.

MR. LAUDER—I think that point is well worthy of a little thought. It is not fair to presume that our English friends would substitute an inferior machine for a superior one. If they are getting better results from the Joy valve gear than we are from the link motion, it must be due to some cause that we do not understand, and it may be due to the cause mentioned by the last speaker. I take it that the Joy gear gives very good distribution of steam and works very well at moderate speed, but when you come to such speed as you have to run here, with five and a half and five foot wheels, the piston speed is too great. I presume in England, where they have higher wheels and a slower piston speed, they may be able to get better results with that gear than we get here.

MR. STRONG—The only thing necessary to make an engine pass her centres smoothly is to have her cylinders clearly filled. For that reason, and the ordinary cylinder having clearances of fifteen per cent. of the area of the cylinder, it is necessary to start the lead very early in the stroke, and get the full boiler pressure at the end of the stroke. Where a cylinder can be made reducing the amount of clearances down, the amount of lead necessary can be reduced in proportion to the clearances. We find on an engine, mentioned as having been built by Mr. Mitchell, with a constant exhaust, only giving three inches compression, that up to eighty miles an hour the engine passes her cylinders as smoothly as possible. There is enough compression to give the full boiler pressure.

On motion of Mr. Sprague, seconded by Mr. Blackwell, the discussion of the report was closed.

THE PRESIDENT—We need a Committee on Resolutions. I would appoint on that Committee the following: W. Fuller, R. Bushnell, F. W. Dean.

On motion of Mr. Woodcock, seconded by Mr. Lauder, the Convention then adjourned until to-morrow morning, June 18th, at 9 o'clock.

THIRD DAY.

Vice-President Barnett called the Convention to order at 9 A. M.

THE PRESIDENT—As announced yesterday, our first business this morning is the reading of an historical paper on the development of radial valve gears, by Mr. Otto Gruninger, Consulting Engineer, of New York.

ON SOME MODERN VALVE GEAR.

More than a generation has passed since the Stephenson Link made its first appearance. It was immediately followed by the modification of Gooch, and later on by that of Allan, and these three designs, so vastly superior to the systems previously in use, quickly superceded them, and they still domineer. Age did not distract anything from their excellent qualities. According to the dictations of circumstances, fancy, real or imagined difficulties in manufacture, one or the other is selected, and they all seem to keep well abreast in the general run of modern locomotive practice. Time has added the nimbus of venerable respectability, and nothing short of the most eminent qualities could enter into a successful competition Attempts have been made in such a direction—even at very early dates—and there is especially one system which, to the present day, enjoys a localized reputation. I refer to the Walschaerts' motion, which is principally used in Belgium, and some parts of France and Germany.

More recently a far more serious competition presented itself, in a gear working entirely without any eccentrics whatever, and which even discards the time-honored link. This gear, the invention of Mr. Chas. Brown, formerly Manager of the Swiss Locomotive and Engine Works at Winterthur, but now engaged in the erection, and subsequently in the management of most extensive steel works in the south of Italy—an offshoot of Sir William Armstrong, Mitchell & Co.'s Works, in Newcastle-on-Tyne—I wish to present to your honorable body in some of its characteristic forms. Mr. Brown has himself made over 600 applications of his gear. It is

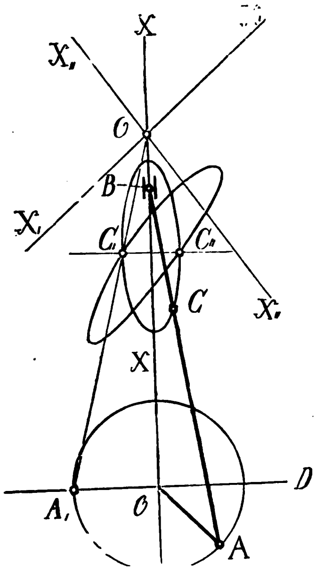


Plate 14.

THE HACKWORTH GEAR.

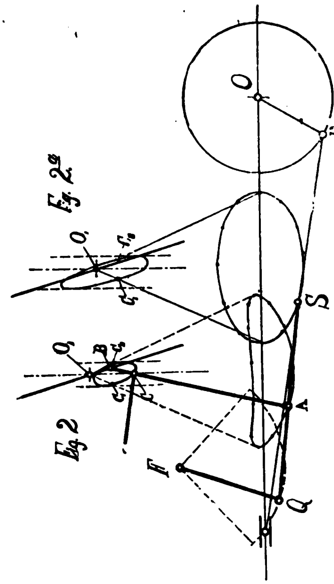


Plate 15.

BROWN'S GEAR.

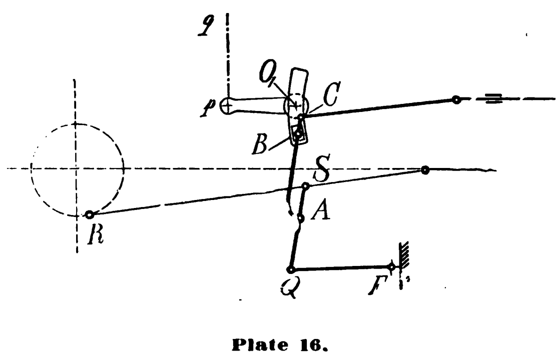


Plate 16.

BROWN'S GEAR, WITH SLIDE AND SLIDE BLOCK.

AS APPLIED 1877.

daily gaining in importance through its perfect working and the simplicity of its design, and I may safely say that the general recognition of its merits is merely a matter of getting personally and practically an insight into its operation.

I have here with me a number of blue prints of the Swiss Locomotive Works, all of forms that were actually built. These may be inspected afterward. For the better demonstration of the underlying principle, I have prepared a series of skeleton sketches; these however, are merely for the purpose of showing clearly the elementary parts, and they possess no claims to accurate proportions.

In one of the forms of Mr. Brown's gear, many of you, no doubt, will recognize at once a motion, of which much has been said and written of late, though passing under a different name. The more so, I think, there will be felt a general interest to learn something of its origin, and of the principle upon which it rests. This brings me back to a reversing valve motion, which was originally patented in France somewhere between 1840 and 1850. It was reinvented and patented in England in 1859 by John Wesley Hackworth, the eminent engineer, whose name and that of his father are so closely associated with the development of the locomotive engine. Hackworth appears to have been the first one to bring it into permanent use, and the gear has been named after him.

In this gear, there is one eccentric only for each cylinder. The free end *B* of the eccentric rod *A B* (see Fig. 1), is made to move in a straight line, and at about one-third from the end of *B*, the valve rod is attached at *C*. As the point *A* revolves about the center *O*, the point of attachment *C* describes a sort of elliptic path. On varying angularly, the straight course of the point *B*, the point *C* still describes an elliptic figure, but with its main axis more or less inclined according to the degree of angular variation in the course of *B*. The diagram shows the elliptic path of *C*, first for a sliding motion of *B*, which coincides with the central line *X X O*, and then for an inclined direction *X X*. For some direction *X*, *X*, the large axis of the elliptic figure would be similarly inclined.

This property in the motion of the point *C* can be utilized in

moving a valve, and this is what Hackworth has done. He placed the crank opposite to the eccentricity $O\ A$, in the direction of $O\ D$, or in other words he placed the eccentric at an angular advance of 90.

The greater the inclination of the large axis of the elliptic figure, the greater will also be the throw of the valve, and the change of the inclination of XX will therefore be the means of obtaining varying throws; that is, varying expansions. If XX is turned to the left of the central line XO into same position X, X, then the motion of the engine will be reversed. For the central position of XX, or mid-gear, the throw of the valve is the smallest, and its amount, the small axis C, C, of the elliptic figure, must be equal to the sum of lap and lead.

The fulcrum O, around the line XX is turned, is of great importance for a correct action of the valve. It is chosen so that whenever the crank is on one of its centers, then B, the end of the connecting rod, occupies just that fulcrum. Hence, no matter what inclination the line XX will be brought to, or whatever degree of expansion is carried, whenever the crank is at its centers, the valve will invariably have returned to one and the same position for all points of the fore and back gear, or in other words, the lead will be constant.

In the practical application of his reversing gear, Mr. Hackworth adopted various modifications of detail. Generally he employed a slot and sliding block for guiding the end of the eccentric rod, but he also used sometimes a radius rod parallel motion. This gear has been adapted in many instances to marine engines. The patent specification also shows an application for locomotives, but it does not appear that this idea was ever carried to practical execution.

Excellent as the gear is for reversing purposes, it has one great disadvantage. For a larger traverse or throw of the valve it is necessary to give XX very large angular distances from the center line—and this is inconsistent with an easy working of the slide—or then the throw of the eccentric must be made disproportionably large.

Mr. Brown applied the Hackworth gear in 1867 to a marine engine. He then found the oscillating motion of the valve stem pro-

duced a sensible error in the motion of the valve, and in order to correct the error he substituted a curved slot for the straight one of Mr. Hackworth.

Subsequently he attempted to do away with the eccentric altogether, and finally by taking the motion from some point of the connecting rod between cross head and crank pin, but retaining Hackworth's rectilinear, or rather corrected curved slide motion, Mr. Brown succeeded in perfecting and producing his present gear. His German patent dates July 28, 1877; his English patent was filed on August 24th of the same year, and it was issued April 9, 1878. Since then, as already stated, Mr. Brown himself has made over 600 different applications, mostly on smaller locomotives, but also on engines of all types.

In order to thoroughly illustrate Mr. Brown's gear, I first introduce a skeleton drawing after his German and English specifications. You will recognize in Fig. 2, the *AB* with the point *C*, in which the valve rod is attached. You will also recognize the course *XX* of the point *C*, also the fulcrum *O* of his course. But the point of *A* is actuated in an essentially different manner. A swinging link *OS* is connected at *S* to some point of the connecting rod, and at 6 to a radius bar *OE* oscillating about the fixed center *F*. The rod *AB* is now attached to a point *A* on the swinging link *OS*.

Following the point *S* of the connecting rod during one revolution of the crank we will observe that it describes a kind of elliptic curve. The nearer *S* is chosen to the crank pin, the more will this curve approach the form of a true circle, and the nearer *S* is taken to the cross head the more will this curve approach the simple form of a straight line. If the end *A* of the pendulum lever *AB*, as we may call this rod appropriately, would be attached directly to the point *S*, then the point *C* would also move in an elliptic path, similarly as in the Hackworth gear, but this motion would be unfit for valve purposes. I have shown this condition in Fig. 2 *A*, and you will observe how unequally the throw of the valve would be to either side of the central line.

Mr. Brown has remedied this defect by the above lever connections. The point *A* of the pendlum lever is made to describe a curve which might be likened to an elliptic figure more or less collapsed on its upper side, and the proportions and dimensions of the

levers are chosen in such a manner as to give an equal throw of the valve to both sides of the central lne.

The system of levers is further so arranged that whenever the crank is on its centers, then the point B of the pendulum lever also coincides with the fulcrum O of the path XX. This insures again a constant lead for all points in fore and back gear.

I have now to describe the method by which the point B of the pendulum lever is guided in its path XX. I exhibit here in Fig. 3 a skeleton drawing from a blue print of the Swiss Locomotive Works. It represents the general disposition of the engine gear of a chain locomotive with vertical cylinders, from the year 1877.

The different elements of the valve gear are easily discerned. We have again the pendulum lever AB, in this case prolonged beyond $B6$ and the point C at the end of the prolongation, where the valve rod is attached to. The point B is in this instance guided by a curved slot, which can be turned around the fulcrum O, PQ is the reversing rod. The curvature of the slot corrects the disturbing influence of the vertical oscillations of the valve rod. I think the gentlemen will already have discovered that this is exactly the gear which two years afterwards, in 1879, was patented in England by Mr. Joy.

In the ordinary link gear the motion of the slide block is altogether localized and only very small for the different points of the gear; here, however, an entirely different task is assigned to the slide block. During each revolution of the driving shaft, and scarcely affected by the degree of the expansion, it has to sweep the entire link to and fro. Mr. Brown soon found that for locomotives the block and slide would wear rapidly, and, unless the roadbed was exceptionally free from dust or sand, this mechanism would form a constant source of trouble. In the above chain locomotive, however, the engines were entirely enclosed and worked through chains to the drivers.

He then designed the following system of compounded radius bars, which after years of application and under the worst conditions of road beds, leaves nothing to be desired:

$n p s$ in Fig. 4 is a double bell crank on the reversing shaft O. XX is the prescribed path of the end of the pendulum lever $a b$. C is again the point of attachment of the valve rod. A radius bar NM

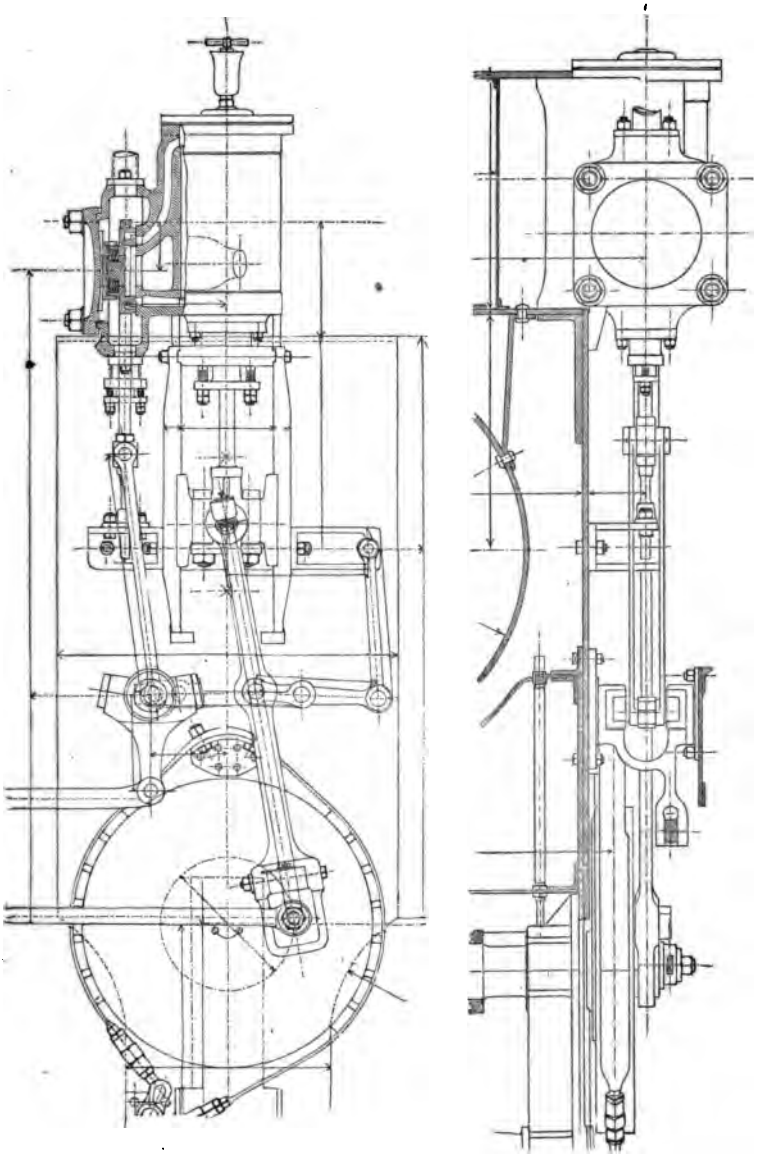


Plate 17.

ELEVATION AND SIDE VIEW OF GEAR FOR CHAIN LOCOMOTIVE.

1877.

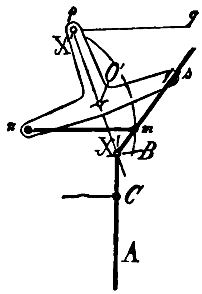


Plate 18—Fig. 4.

BROWN'S COMPOUND RADIUS BAR.

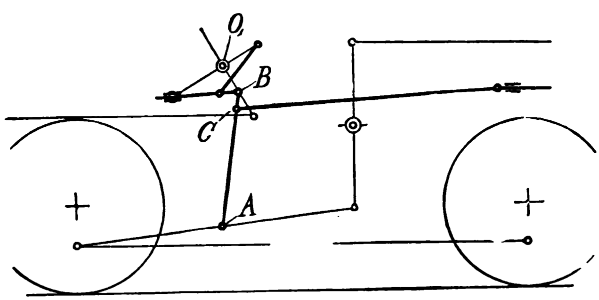


Plate 19.

BROWN'S GEAR, WITH COMPOUND RADIUS BAR.

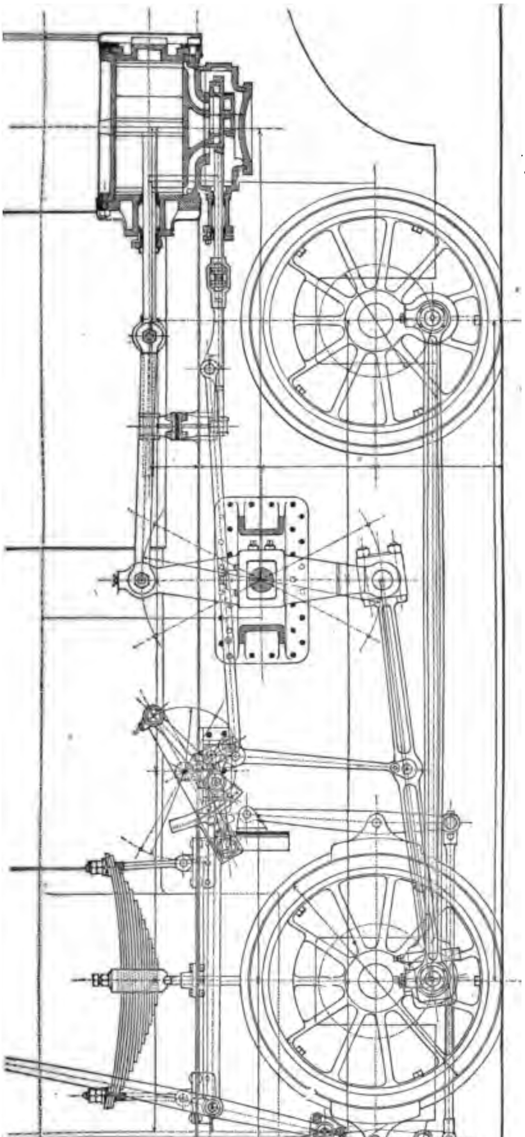


Plate 20.

BROWN'S GEAR ENGINE.

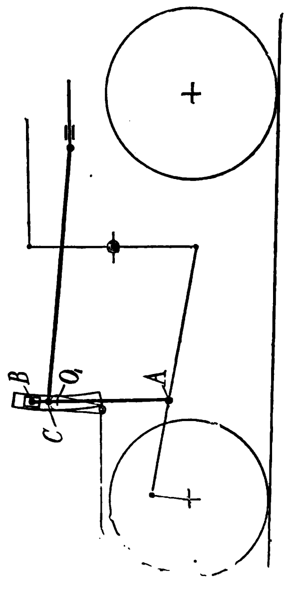


Plate 21.

Fig. 6. BROWN'S GEAR WITH SLIDE AND SLIDE BLOCK FOR ITALIAN ENGINES.

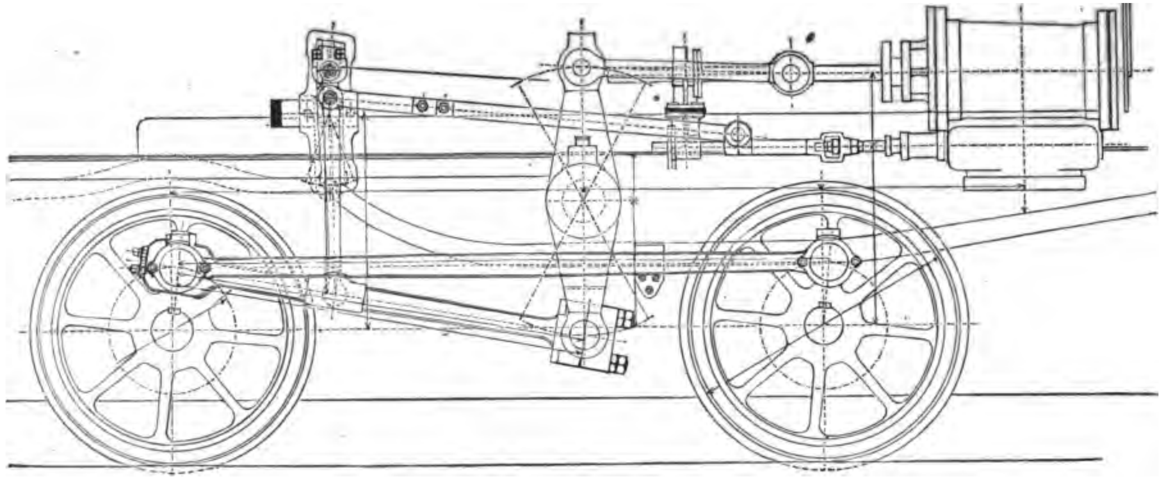


Plate 22.

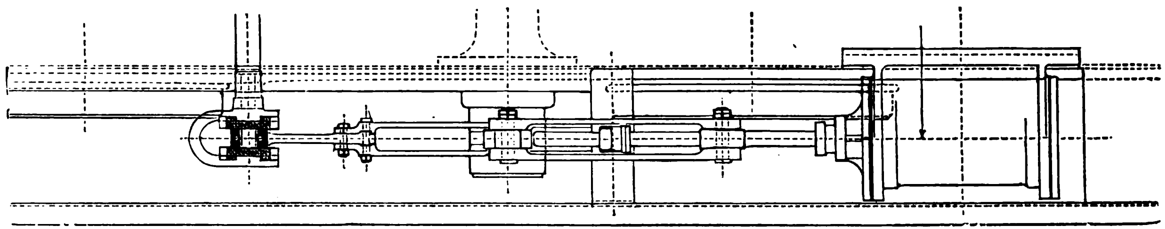


Plate 23.

Fig. 6a. ELEVATION AND PLAN OF BROWN'S GEAR FOR ITALIAN ENGINES.

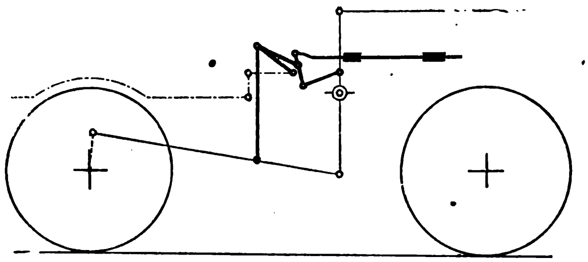


Plate 24.

Fig. 7. VARIATIONS OF BROWN'S GEAR, ENGINE FOR RAPPOLTSWELL.

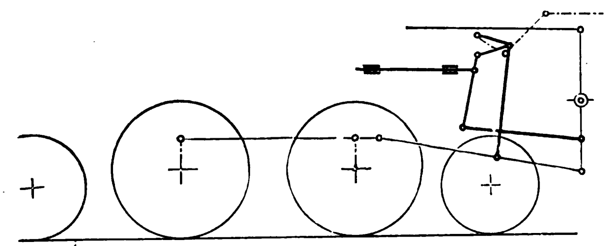


Plate 25.

Fig. 8. VARIATIONS OF BROWN'S GEAR, ENGINE FOR MUHLHAUSEN.

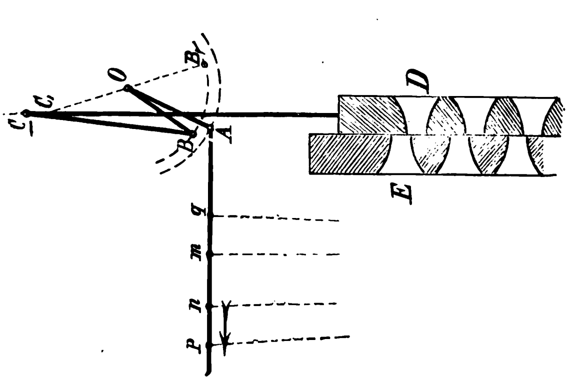


Plate 26.

Fig. 9. STRONG'S PAT. VALVE GEAR.

vibrates around the point *N.* In *M* a second vibrating link *Bt* is attached oscillating around the point *s*, but at the same time having a rectilinear sliding motion through the same. *B* is the point of attachment of the pendulum lever. It will be noticed that as *m* approaches its central position, the angle *n m b* diminishes, and *B* is made to approach the point *n*, that is, move in that direction. The point *B* therefore describes a certain curved line *X, X*, and the amount of curvature, commencing with an almost straight line, can be controlled within all practical limits by the proportionate dimensions of the compound radius bars.

The principal thrust from the valve rod is taking up by the radius bar *n m* and but a comparatively slight portion is thrown upon the swivel joint *s*. Experience has sufficiently demonstrated that the wear at that point is very slight. This ingenious device of compounded radius bars admits of a very compact and neat construction; it gives complete control over the curvature of *X, X*,—and on account of this—over a perfect motion of the valve. The most careful construction of type of Mr. Brown's gear is that of Figs. 5 and 5*a*, Plates 19 and 20, representing the gear of engines of the Toossthal Railway in Switzerland. The engines were built in 1884. They were in every respect a first rate job, especially for local trains running at a high speed. They exhibit remarkable steadiness owing to the use of the rocker.

The end of the connecting rod, attached to the rocker, has to move through part of a circle, and for this reason, a point *A* of the rod describes already an elliptic figure sufficiently flattened on its upper side, to make any further correction unnecessary and to admit of direct attachment of the pendulum lever to the connecting rod. This makes the gear very simple and it produces an almost mathematically correct valve motion.

A number of engines were built for Italy in 1882. Figs. 6 and 6*a*, plates Nos. 21 and 22, shows the general disposition of the gear. At the special request of the master mechanic of the line, Mr. Brown had to use the slide block and grooved link. The simultaneous employment of the rocker made the valve gear very simple and acceptable to the eye, but the subsequent wear proved to be very great.

I may mention here that in a very recent design of a small engine without rocker, Mr. Brown connected the lower end of the pendulum lever directly with the coupling bar, instead of with the

7

connecting rod. The general arrangement of the engine allowed this design. It produced a valve gear of extreme simplicity.

Figs. 7 and 8 show Mr. Brown's versatility in the application of the leading idea of his gear. Fig. 7 was designed in 1879 and represents the gear engines built for Rappottsweil; Fig. 8 dates from 1881 and the engines were built for Muhlhausen. Both types had rockers. The valve rods have a rectilinear motion only and they receive it in a manner quite analogous to the Walschaerts gear: with the essential difference however that the eccentric of the latter has been substituted by Mr. Brown's connection with the connecting rod. This type with short radius bars may be somewhat simpler in appearance than the system of compounded radius bars. But it is not so easy to handle with the reversing lever, indicating that there are severe strains present, due to the shortness of the radius bars.

Taking all together, the gears with compounded radius bars, notwithstanding a little extra complication, are to be preferred, as easy handling and reduction of strains on the valve gears are matters of prime importance.

When comparing Mr. Brown's gear with the present different link motions, the first question that will arise, concerns the distribution of steam. And in this respect it may be said, that it combines all the virtues of the best gears in use. It has a constant lead like that of Gooch or Walschaerts, and it allows the greatest ranges of expansion with a correctness in action that is only obtained in the best of the other designs. Its manufacture is simpler and cheaper, and in discarding with the eccentrics and by producing all rotations around pins of very small diameters a not inconsiderable source of frictional losses is abolished. It has been tried severely on a large number of tramway engines, street dummies and locomotives running on dusty sandy tracks, and it has done excellent service under circumstances, where eccentrics have given a great deal of trouble. Its wear is inconsiderable, but when worn, a few bushings will set all right.

Another and not unimportant consideration in its favor is that it gives more room about the axle.

Then, being on the outside of the frame, all its parts are under the direct supervision of the engineer, and are readily got at and inspected. I presume the placing of the valve gear on the inside

of the engine frame is more a matter of custom and habit, than that very urgent reasons should exist for it. Continental practice, for instance, which as a rule has outside cylinders in common, with American types, almost invariably places the valve gear to the outside of the frame and many years of experience have not altered this custom.

I am passing now to a new valve motion, the design of Mr. Geo. S. Strong of Philadelphia, which in many important respects radically deviates from usual custom. Mr. Strong has made valve motion in its application to locomotives a special study. In carrying out his present designs, he was principally actuated by the idea of producing a gear which under almost any conditions of speed would practically give uniformity between boiler and admission pressure, that is, do away with wire drawing, and which also would reduce back pressure to the lowest possible point But besides these considerations there were to be observed the imperative demands for easy working, slight wear and security against derangements, as well also as facility in manufacturing.

To lessen wire drawing we must have large port areas and a rapid opening and closing of the valves; and to reduce back pressure, especially at the early points of cut-off we must besides separate the function of exhausting from that which governs the admission of steam.

To obtain large port areas, Mr. Strong applies grid-iron slides, and in order to carry expansion to the greatest extent without involving an excessive compression, he makes use of independently worked valves for admission and for exhaust. There are two valves to each cylinder, and all of them are worked independently.

The port area which Mr. Strong obtains in an engine with 19x24 cylinders is 50 inches long by ¾ inches in width, and this feat, together with a total clearance for each cylinder end of only four per cent. of the cylinder volume, was made possible by placing the long grid-iron valves vertically and at right angles to the axis of the cylinder, and bringing them close up to the cylinder walls. The arrangement resembles somewhat the disposition of the valves in a Corliss engine; but here the slides have a rectilinear up and down movement, and the two valves of each cylinder end are placed on the same side of the cylinder, and close to each other.

Their movement is the result of the combined action of two distinct mechanisms. The duty of the first one is to receive the primary impulse of motion from the running gear of the engine and impart it to the second mechanism, a system of levers or rockers, in a properly modified form.

The first mechanism is nothing else but an adaptation of the Brown gear. Instead of using Mr. Brown's compounded radius bars, Mr. Strong substituted one single radius bar, the fulcrum of which is located on a block, which, by sliding on a fixed quadrant, can be brought into the different positions of fore and back gear. This block, properly called a thrustblock, takes up the thrust of the valve rod, and if its position on the quadrant is to be changed, only the frictional resistance of the block, and whatever tangential component of the thrust there should exist, have to be overcome. This gear admits of very easy handling. An engine with 160 pounds of steam can be reversed with full steam on with one hand.

Where the general disposition of the engine will admit of a single radius bar of sufficient length—a condition not always readily fulfilled, when the valve is to be worked *directly* from the pendulum lever—this device may be employed, while, as I pointed out before, Brown's compounded radius bars always give complete control over the curvature of the path *X*, *X*. In Mr. Strong's case, where there exists a system of rockers to modify the motion before it reaches the valves, any shortcomings in the distribution of steam that may result from too short a radius bar can be corrected by proper dimensions of the rockers.

The motion, when it reaches the rockers, is similar to that of an ordinary slide valve; figure 9, plate No. 26, will illustrate how essentially they modify it. *E* is the valve seat, and *D* the valve. The motion from the Brown gear is communicated to a lever or rocker *O A*, which imparts it to a second lever *O B* on the inside of the steam space. A link *B C* connects the lever *O B* with the valve. The figure shows the moment where the crank pin is on its centre; the valve has opened the port by the amount of the lead and the position of *A* corresponds to the position *n* of a point of the outside valve rod: *n m* is the distance the valve rod has to travel in mid-gear, and with a direct connection to an ordinary slide valve,

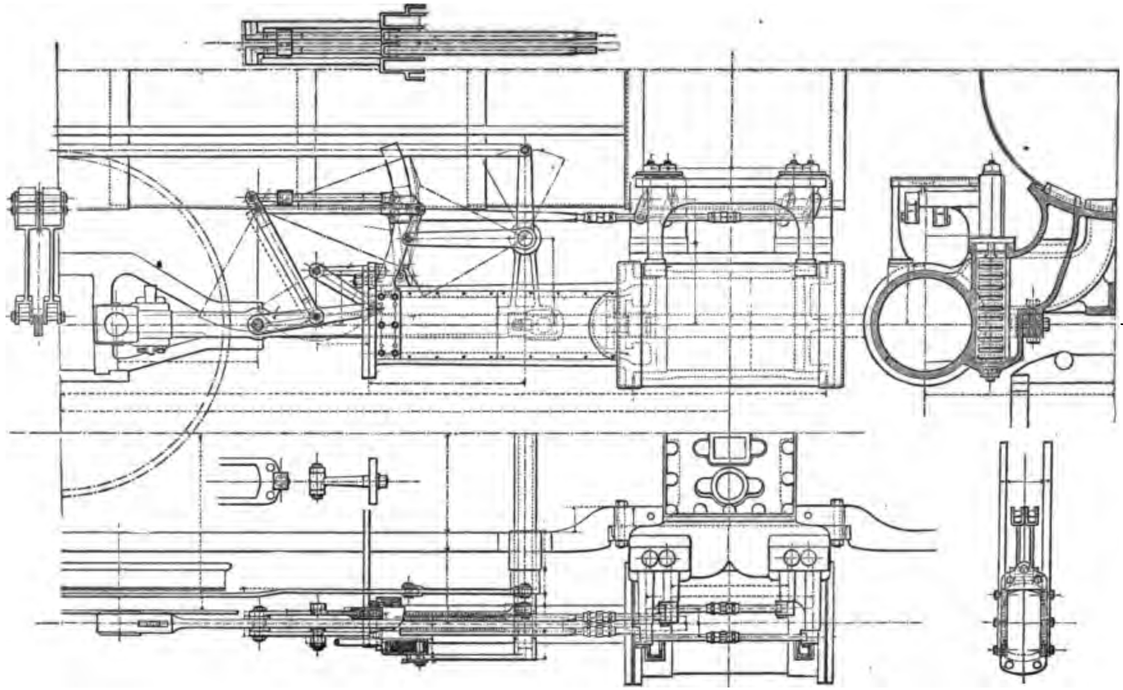


Plate 27.

Fig. 9a. STRONG'S PATENT VALVE GEAR AND VALVES. ELEVATION AND PLAN.

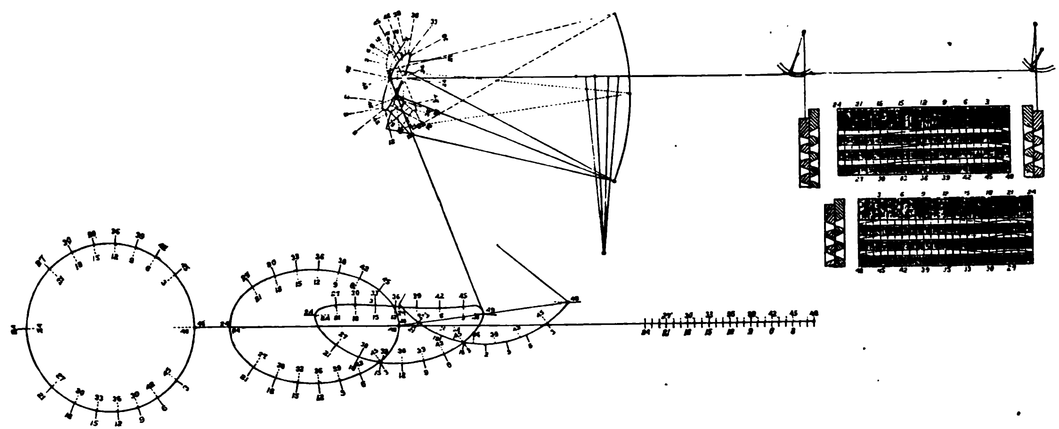


Fig. 9b. STRONG'S PATENT VALVE GEAR AND VALVES. General Disposition.

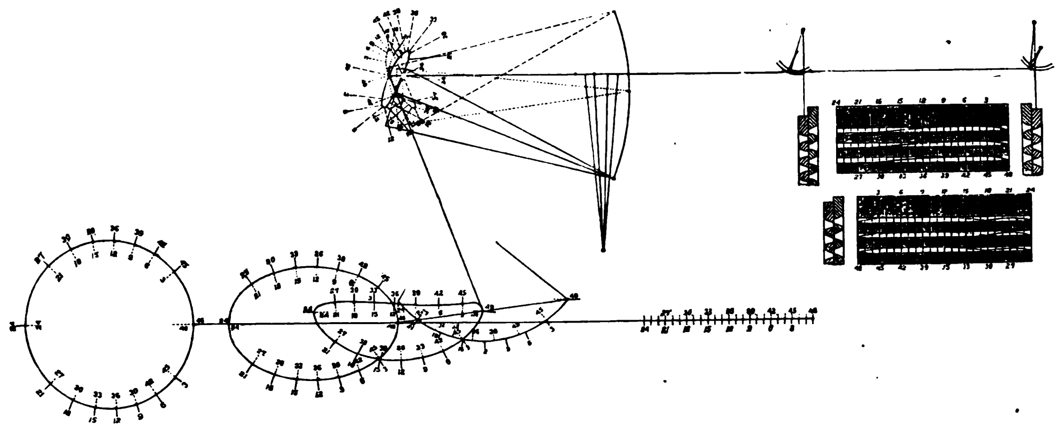


Fig. 9b. STRONG'S PATENT VALVE GEAR AND VALVES. General Disposition.

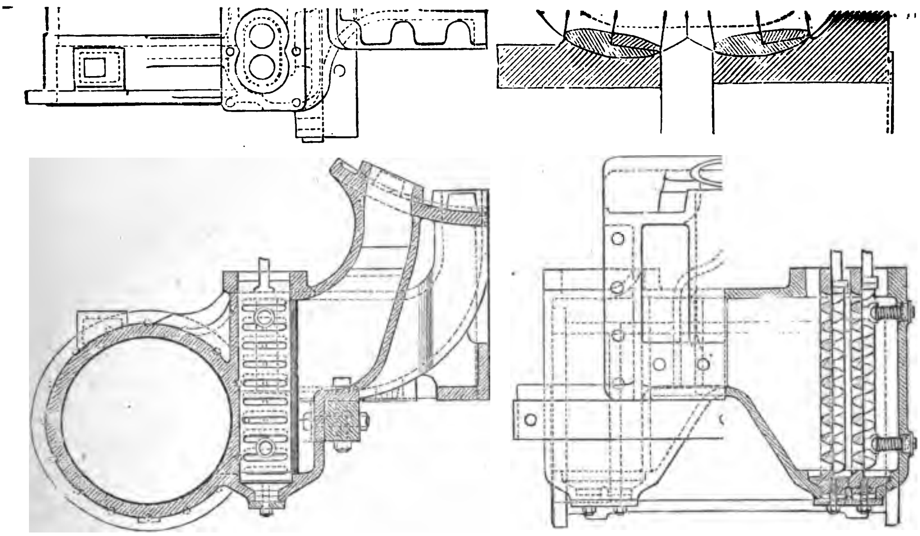


Plate 29.

Fig. 9c. DETAILS OF STRONG'S PATENT VALVES, SHOWING VALVE SEATS

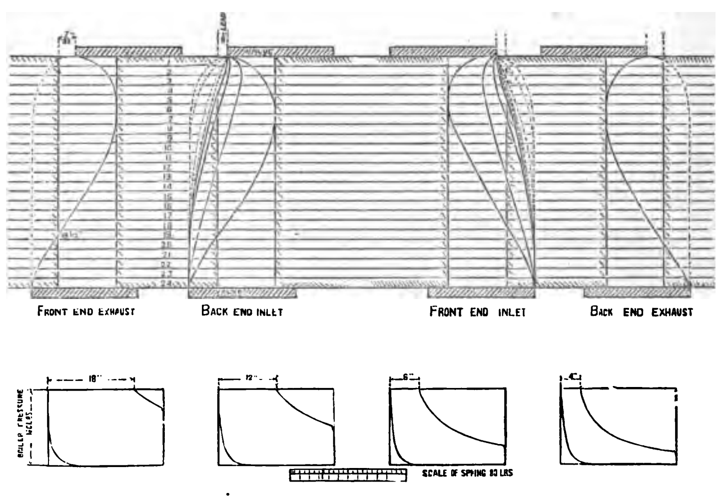


Plate 30.

Fig. 9d. STRONG'S VALVE DIAGRAMS.

port areas, together with the rapid action of the valves, admission pressure is carried within one or two pounds of boiler pressure, and it is carried out to the point of cut-off without anything like the loss experienced with an ordinary valve.

The peculiar intermittent motion of the grid-iron slides—similar in effect to the action of cams and tappets—takes the wear from them, and it affords the best balance possible without any balancing device. I may mention that valves constructed on this principle, but operated by cams, have been at work for twenty years, night and day, and they are as tight now as when started.

There is no steam chest on the cylinders. The valves are interposed in the passages, and the passages are very large, affording a free steam supply and a free exhaust. Concerning weight, the cylinders on a 19x24 engine are 800 pounds lighter than those of the regular type with chest and ordinary valves. And with regard to manufacture, the valve seats are introduced by boring entirely, as you will observe on examining the blue prints. Planing and slotting is done away with, except the planing for the frames, saddles and truck centres. The cost of cylinders and valve gear, with equal facilities, can be reduced below the cost of the customary link motion and ordinary cylinders, and the former will wear far better than the latter.

Uniformity of detail and standard sizes are aimed at in all branches of practical railroad operation. To think of general standard sizes with such a complicated mechanism as we have in our engines, seems almost to border on the ridiculous, and yet with Mr. Strong's gear, two standard sizes would answer all classes of locomotives, one for four, and another one for six, eight and ten couplers. Everything might be reduced to a few standard parts. Drop forgings to standard dies, and finishing limited to working faces, would most essentially simplify manufacture and cost.

Mr. Strong's innovations are bold, but the reasoning is sound, and his plan offers decided merits. Experience will decide.

OTTO GRÜNINGER.

On motion of Mr. Woodcock, seconded by Mr. Setchel, the paper was received.

Mr. Setchel—For the information of the Secretary I would like to inquire whether receiving this paper implies that it shall be printed.

and the drawings engraved and published in our report? It is very voluminous, and will cost a great deal to do it.

MR. LAUDER—I was about to make a motion, which perhaps I will do later, that all these papers from outside parties be referred to the Supervisory Committee, that Committee to have full power as to what disposition shall be made of them.

MR. BRIGGS—If that is put as a motion, I second it.

MR. SPRAGUE—I am glad our association begins to understand that outside persons can draw up papers without having some patentable or self-interest in them.

MR. BRIGGS—I think it should be generally understood that everything in our line of business which has merit in it should be presented to us. We want to know as soon as these things come to the knowledge of the world what they are, in order to be able to discuss them and take advantage of them; but I am with Mr. Lauder to refer it to a committee first, and let them decide upon the merits of the paper. We cannot expect to derive benefit from anything—unless it comes from our own experience—except some one gives it to us; but at the same time it should come before the Convention in proper shape.

THE PRESIDENT—For the benefit of the members I would say that this paper was submitted to the Supervisory Committee before it was read, so that the Committee knew what the paper contained.

On motion of Mr. Swanston, seconded by Mr. Blackwell, a vote of thanks was tendered to the author of the paper, and the discussion of the same was closed.

THE PRESIDENT—The next business in order is the report of the committee on new plans for construction and improvement in locomotives.

Mr. Setchel here read the report referred to.

THE PHILADELPHIA AND READING RAILROAD COMPANY
ELIZABETHPORT, N. J., April 30, 1885.

To the American Railway Master Mechanics' Association:

GENTLEMEN:—Your Committee appointed to report on the subject of new plans for construction and improvement of the locomotive herewith presents the following report:

The Committee prepared a circular soliciting information on this subject, and judging from the replies received, not much improvement has been made during the past year, or else our members are too modest to mention the facts. However, we believe the continued depression in business on our railroads, forbids any radical changes in the construction of the locomotive at present. A number of new plans, or theories, of new construction have been

brought out during the past two or three years, but they have failed to produce the desired results, to warrant their adoption. The tendency among our master mechanics now is to so construct the locomotive as to reduce the cost of repairs and to secure greater efficiency of service, by the use of good material, workmanship and exercising proper care of the same when in service. Mr. M. N. Forney, mechanical engineer, has furnished your Committee with cuts Fig. No. 1 and 2, describing plan of improvement of the locomotive in the matter of increasing traction, also position of driving wheels to permit of increased width of fire box, also manner of coupling engine and tender together with truck to support weight of both combined, also manner of adjusting weight on driving wheels by using steam or air cylinders. Also plan of equalization with springs or levers. Mr. Forney advises that no engine has as yet been built from these plans, but is looking forward to the near future when they shall be put in practice.

The Baldwin Locomotive Works have recently completed a locomotive on a new plan (see photo. F), known as Decapod class, having five (5) pairs of driving wheels and a pony truck. The cylinders are 22″ diameter and 26″ stroke, diameter of driving wheels 45″. The arrangement of flanged wheels is such as to enable the locomotive to pass ordinary curves without difficulty, and has been designed for working on curves of 330 feet radius. The first, fourth and fifth pairs of driving wheels have flanges. To reduce the friction when passing curves the rear driving wheels have additional play—the rigid wheel base is therefore practically only the distance between centers of the first and fourth driving wheels, viz: 12 ft. 8 in., which is less than that of either a consolidation or Mogul locomotive of ordinary type.

The principal dimensions are as follows:

Gauge	5 feet 3 inches.
Actual weight in working order, exclusive of tender	144,000 lbs.
Actual weight on driving wheels	128,000 "
Estimated weight of tender, including fuel and water	80,000 "
Estimated weight of locomotive and tender in working order	224,000 "
Cylinders	22″ x 26″
Driving wheels—five (5) pairs coupled	45″ diameter.
Total wheel base	24 ft. 4 in.

FIG. 1.

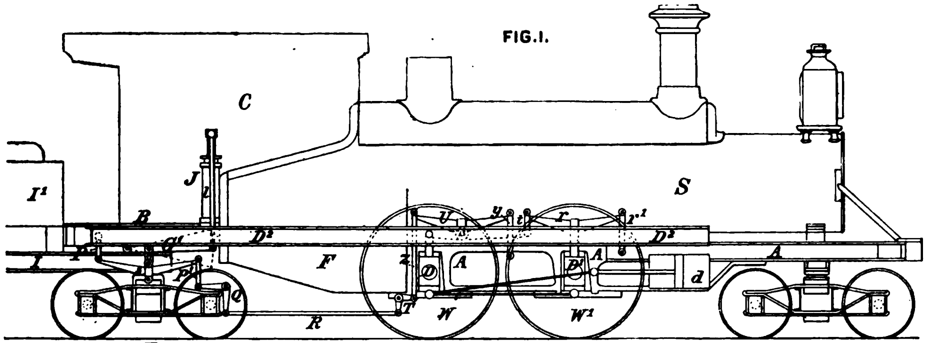


FIG. 2.

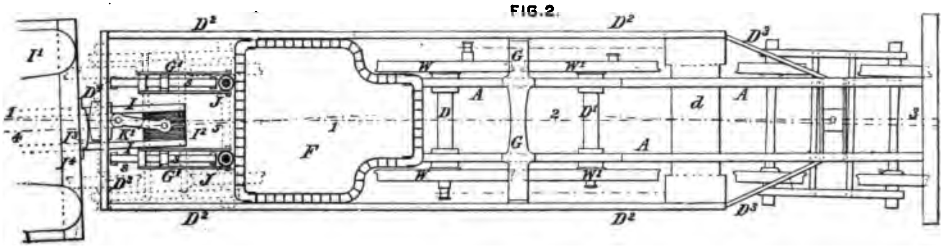
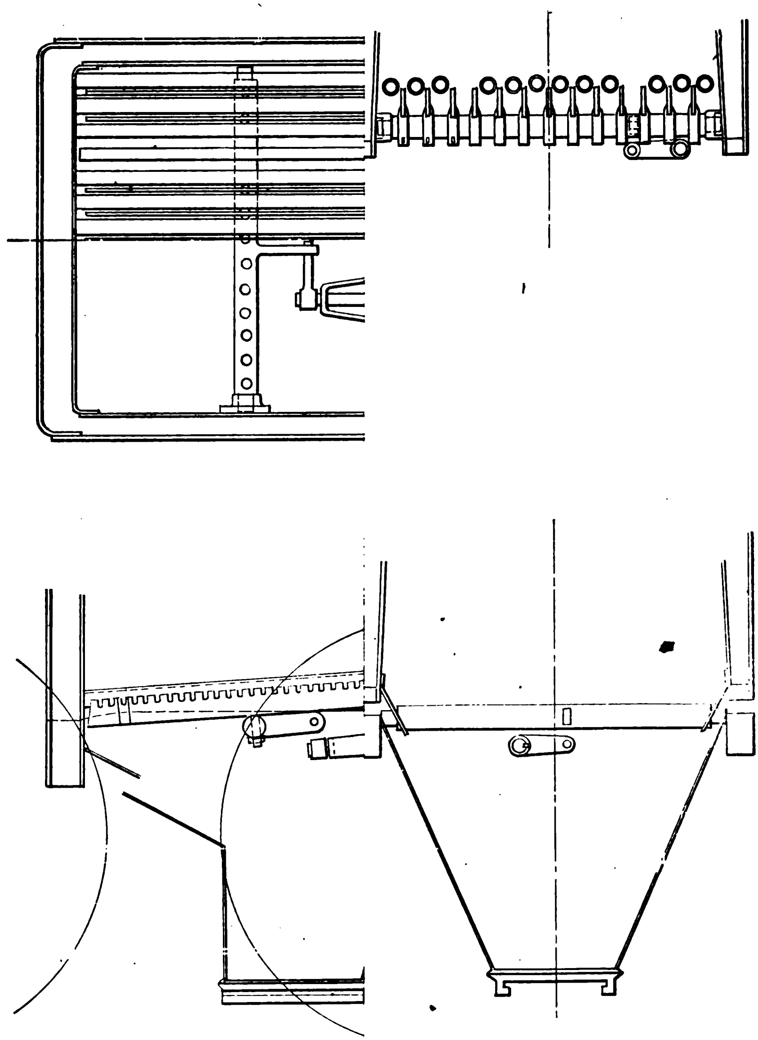


Plate 31.

M. N. FORNEY'S PATENT LOCOMOTIVE.



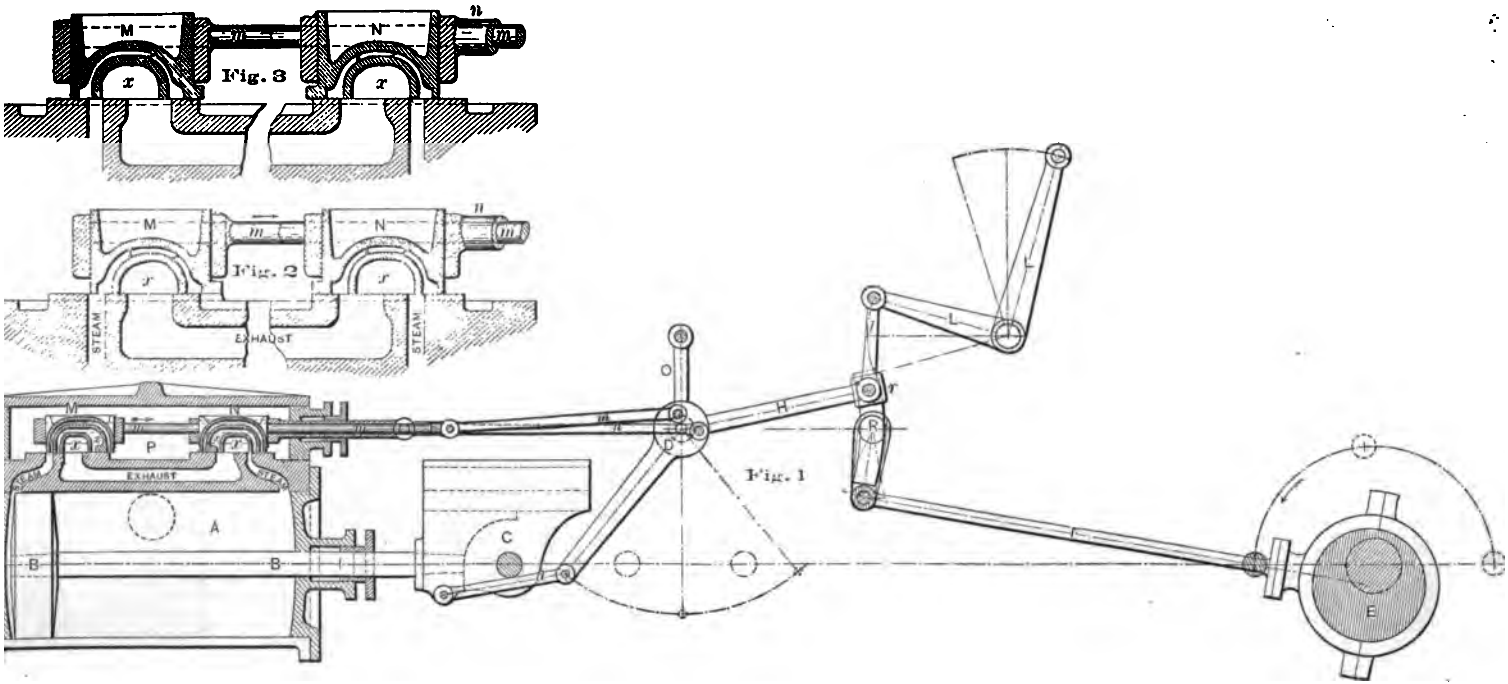


Plate 34.

INDEPENDENT CUT-OFF OF DAVID CLARK. L. V. R. R.

Driving wheel base	17 ft. 0″
Rigid wheel base	12 ft. 8″
Boiler of iron, $\frac{5}{8}$″ thick	64″ diameter.
Right of center line above rail	7 feet.
Fire box	10′ 1″ long by $39\frac{1}{2}$″ wide inside.
Tubes	268 in number, 2″ diameter, 12′, $9\frac{1}{2}$″ long.
Heating surface of fire-box	160 square feet.
Heating surface of flues	1,783 "
Total heating surface	1,943 "
Tank capacity	3,500 gallons.

The estimated tractive power, in tons of 2,240 pounds, of cars and lading on level track, and on straight grades of from one to four per cent., track and cars being in good condition, is as follows:

Level	3,600 tons.
1 per cent. or $52\frac{8}{10}$ ft. per mile	970 "
2 " " $105\frac{6}{10}$ " "	500 "
3 " " $158\frac{4}{10}$ " "	320 "
4 " " $211\frac{2}{10}$ " "	220 "

This locomotive was built for the Dom Pedro II. Railway, of Brazil. We herewith enclose photograph of same.

Mr. David Clark, M. M. of Lehigh Valley R. R., has furnished your Committee with blue prints of a ten (10) wheel locomotive, built at the Hazleton shops of that company, and used in freight service (see Plate No. 4). The fire box is adapted for burning anthracite coal-dust, or slack from the mine. The grate arrangement used in this fire-box is a combination of water tubes and wrought iron bars; the bars are placed in between the water tubes in sections, supported and connected by cross shafts, and form an arrangement by which the bars can be rocked or moved to clean fire. The arrangement is shown on Plate 33.

Another feature of this engine is the arrangement of an independent cut-off valve in connection with the usual link motion; the details of this arrangement are fully described in Plate 34. In a recent trial of this engine, Mr. Clark says, the performance was quite satisfactory, and engine steamed freely. It will be noticed that this is quite a large boiler, and fire-box is placed on top of frames. Boiler and fire-box are built of steel, having a total heating surface of 2,063 feet. The principal dimensions are as follows:

Guage	4′ 8½″.
Cylinders	20″ x 26″
Tubes, 275—2″ diameter	1,890 sq. ft.
Fire-box, 11 ft. long, 3′ 8″ wide	173 "
Total heating surface	2,063 "
Grate area	40 "
Travel of valve	$4\frac{9}{16}$″; outside lap, ⅝″; inside, $\frac{1}{16}$.
Lead "	$\frac{3}{32}$″ to $\frac{7}{32}$″.
Travel of cut-off valve	$3\frac{1}{16}$″ to $4\frac{13}{16}$″.
Steam ports	1¼″ x 17″.
Exhaust	2½″ x 17″.
Weight of engine with fire and water	109,600 lbs.
" on drivers	92,000 "
" " truck	17,600 "
" of tank	55,000 "

H. S. Bryan, M. M. of Chicago & Iowa R. R. Co., furnished blue print of new plan of constructing crown sheet for fire-boxes (see plate 35), the peculiarity being that crown bars are not used; the sheet is made up in sections, as shown, insuring the requisite strength. Among the advantages claimed are:

1st. Greater strength obtained.

2nd. A better circulation of water.

3rd. All parts of crown sheet are accessible, and can be readily washed off and kept clean without removing braces.

4th. Liability of mud and scale collecting thereon is avoided.

5th. Economy in construction.

Mr. Bryan states that this style of crown sheet has been in service for the past seven years with very satisfactory results.

Mr. Geo. W. Stevens, Superintendent Motive Power of the Lake Shore & Michigan Southern R. R., in reply to the subject of "Lagging for covering locomotive boilers," furnishes your committee with blue prints (see Plate 36, 37, 38 and 39), illustrating his mode of covering fire-boxes and boiler heads on that road, which is by placing a sheet of asbestos one-quarter of an inch thick on boiler. On top of this is placed hair felt one (1) inch in thickness, over which is placed kalamein or planished iron. Detail plans of brass extensions for gauge cocks, and thimbles for stay bolts, are also shown in prints. No data is given of durability and economy, as compared with usual mode of lagging with wood. Your Committee is of the opinion that a more durable

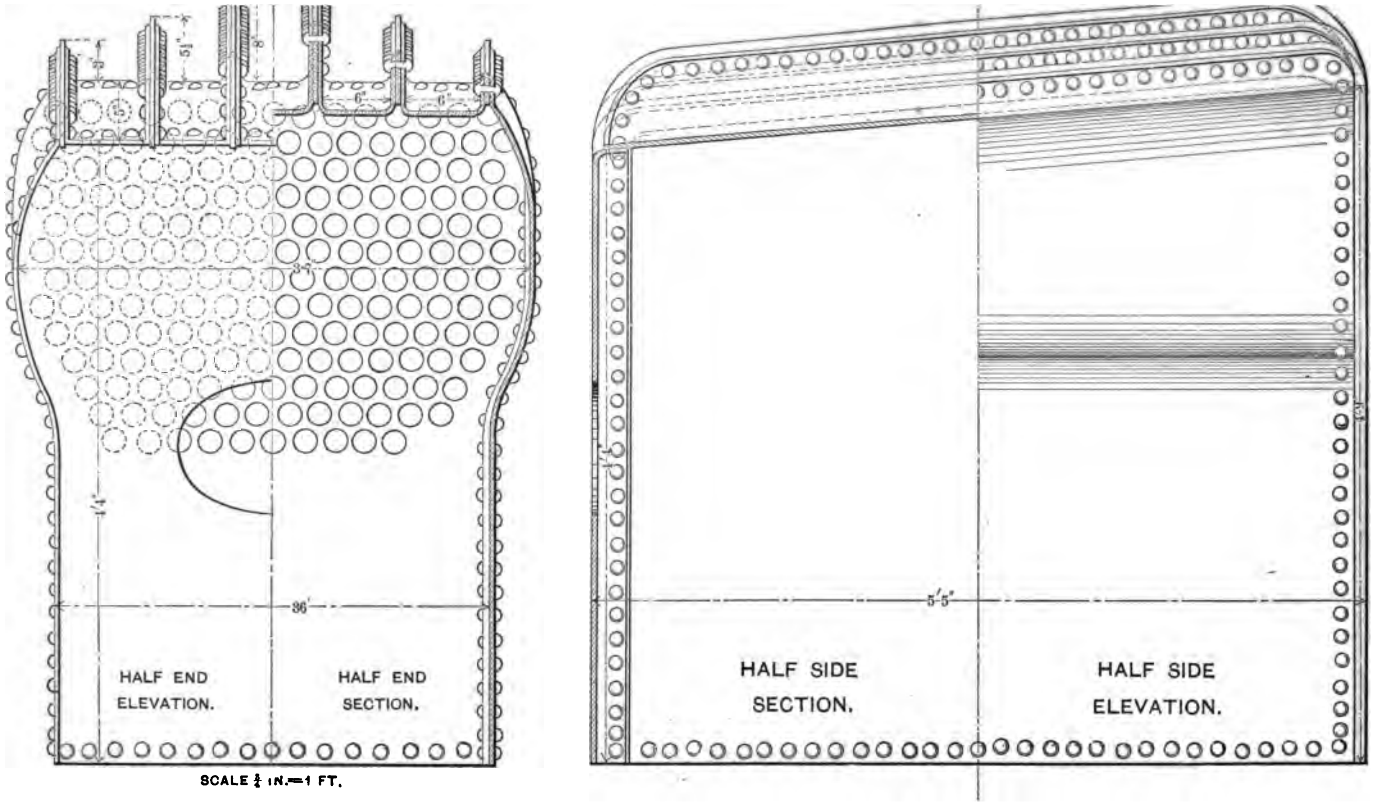


Plate 35.

H. S. BRYAN'S CROWN SHEETS FOR LOCOMOTIVES.

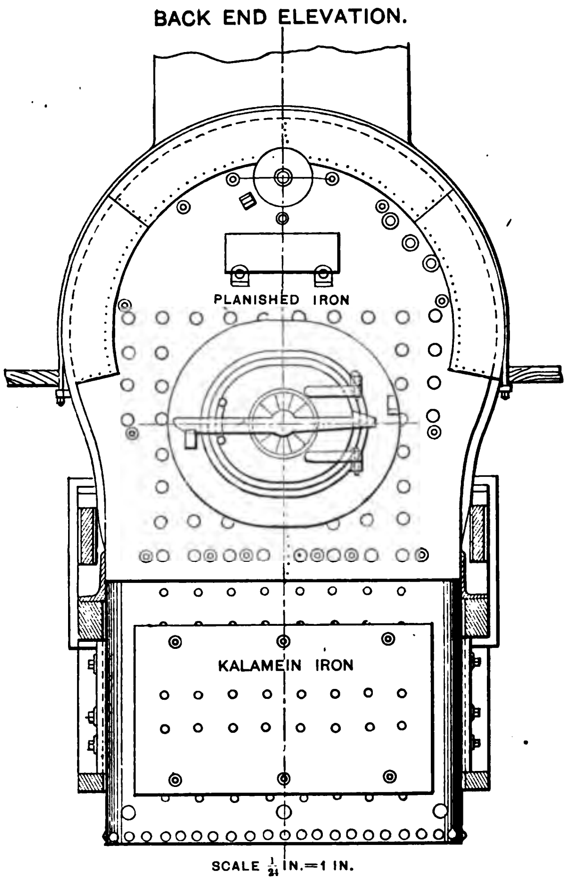


Plate 36.

GEO. W. STEVENS' COVERING FOR FIRE-BOXES.

L. S. & M. S. R. R.

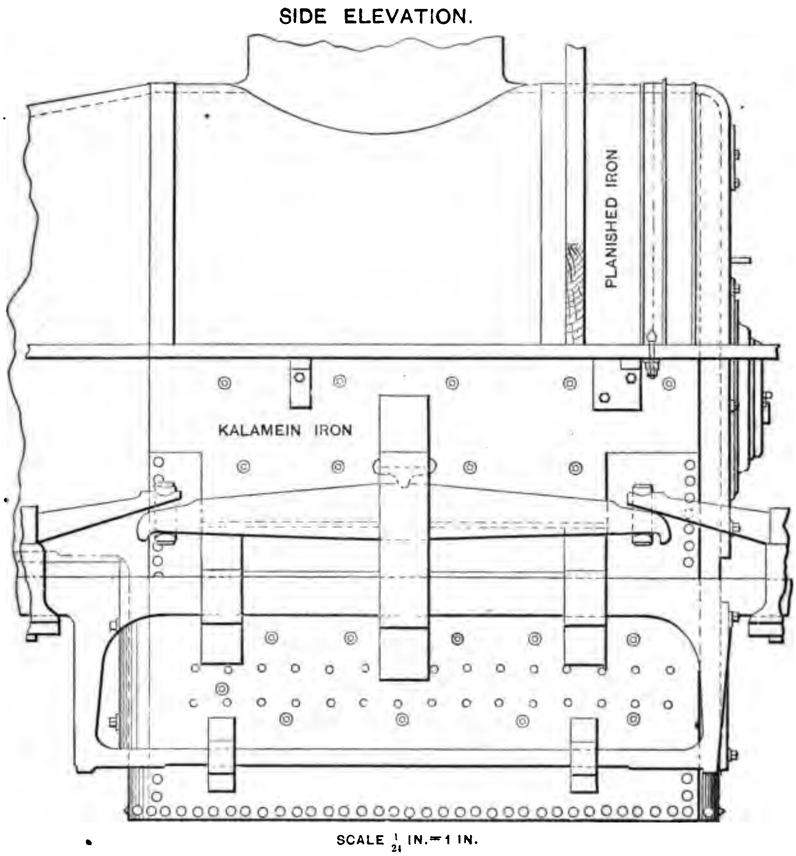


Plate 37.

GEO. W. STEVENS' COVERING FOR FIRE-BOXES. L. S. & M. S. R. R.

ELEVATION OF THROAT SHEET.

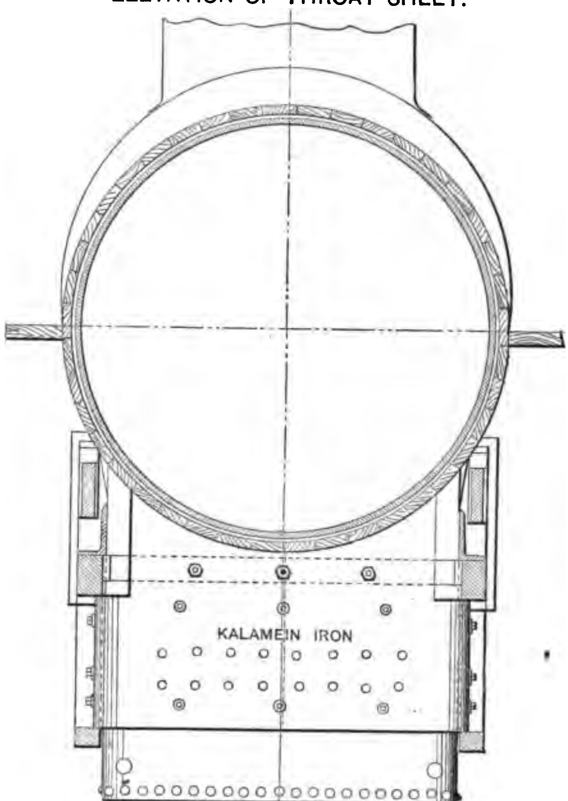


Plate 38.

GEO. W. STEVENS' COVERING FOR FIRE-BOXES.

L. S. & M. S. R. R.

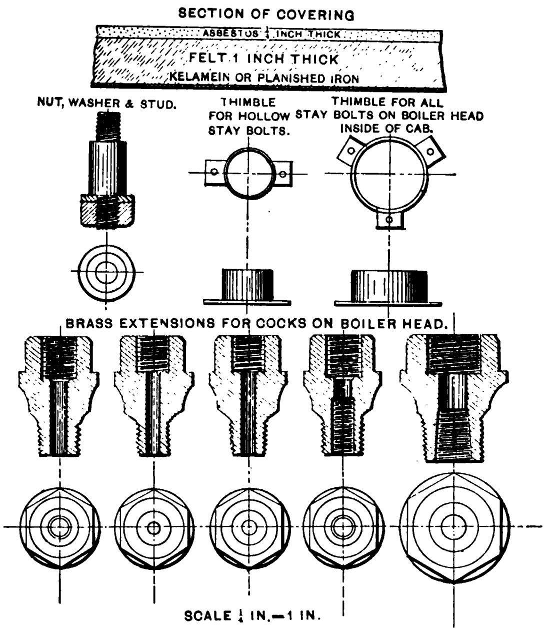


Plate 39.

GEO. W. STEVENS. L. S. & M. S. R. R.

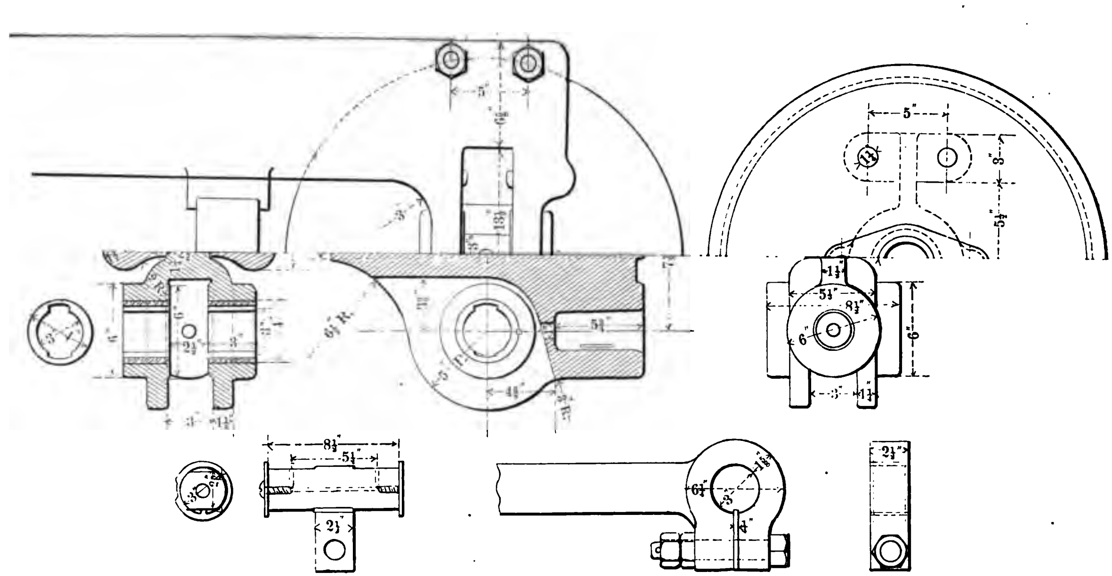


Plate 40.

F. M. DEAN'S LOCOMOTIVE GUIDE. Pat. Oct. 24, 1882.

Crosshead Cast Steel. Guide Cast Iron. Gibs & Bushings Phosphor Bronze.

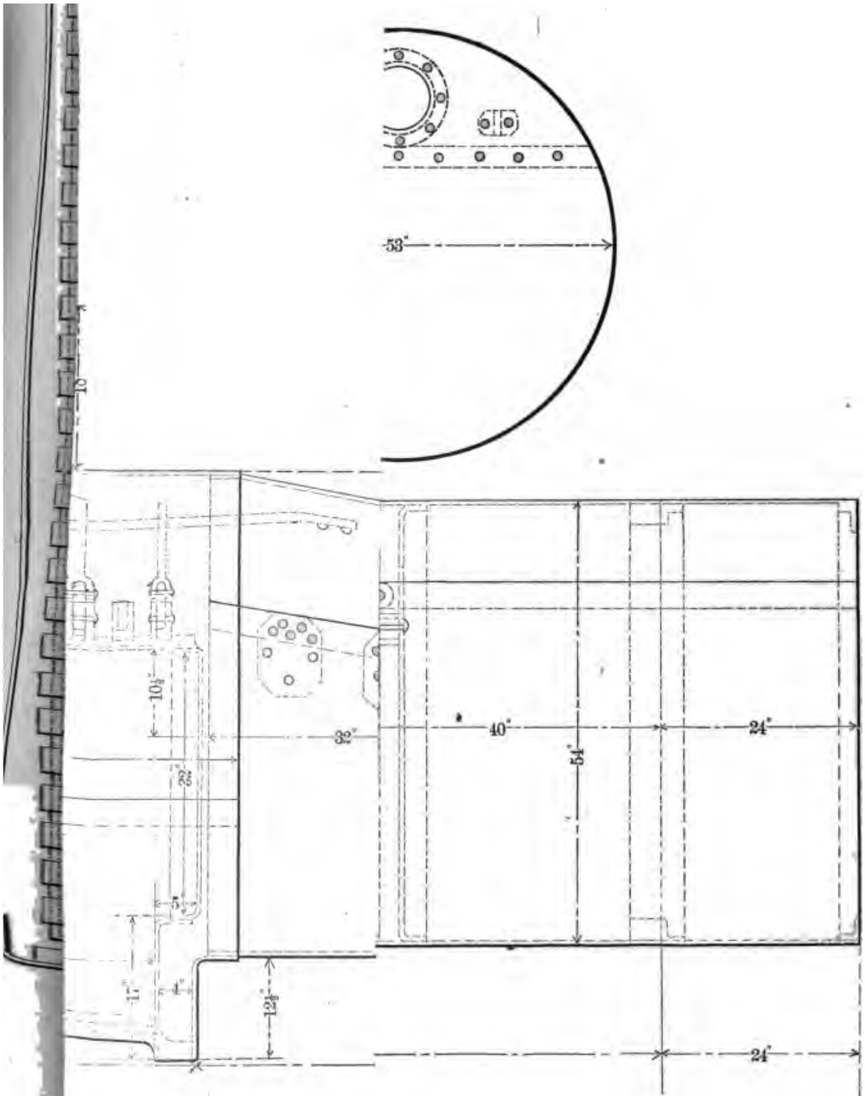


Plate 41.

VE BOILER L. V. R. R.

n Campbell, M. M.

.ng or covering for locomotive boilers is desirable, also as a er of economy, as wood lagging, put on in the usual manner, mes charred or burned, and is also liable to take fire from ks and cause trouble. We find that a number of our master hanics are giving this matter attention by testing several kinds oiler covering.

Our Committee finds that the matter of compound locomotives ceiving some attention of late, but we have not sufficient data et to present the subject fully before the Convention at this . Mr. J. Davis Barnett, Assistant Mechanical Superintendent rand Trunk Railway of Canada, writes your Committee that xpects to conduct some experiments with a compound locove recently brought out on their road, it having a high and pressure cylinder on each side of engine—the distribution of n being effected by one balanced slide valve working between wo valve faces, with the result of not complicating or adding more parts to the present gear. Mr. Barnett states that this ngement possesses some advantages over the other systems of pound locomotives now in operation. The results of same be anticipated and awaited with much interest by the mechanworld.

r. F. W. Dean, mechanical engineer, of Cambridge, Mass., shes your Committee with blue print, showing plans of imed locomotive cross head and guide (see Plate 40). The claims his improvement are, increased strength and wearing surfaces. construction of this guide keeps out dust and cinders from vorking surfaces. Also, the guide, being of box form, is very During two years' service on one of the Eastern railroads, s given entire satisfaction running in express passenger ser- The construction of the cross-head and connecting rod shes over double the usual bearing surface for the crosspin, and is well adapted for express service.

r. John Campbell, M. M. of Mahoney Division of the Lehigh y R. R., has furnished your Committee with blue prints, ing design of new boiler built at their Delano shops, for ing anthracite coal, for passenger service (see Plate 41). ng the peculiar points noticed in the construction of this r is :

1st. The extending of side sheets of fire-box **one (1) inch** above top line of crown sheet, and front of crown **bars resting on** the edge of side sheets.

2nd. On inside of laps the sheets are champerred **one-eighth of** an inch in thickness on end of sheet, and sharp **edge of sheet is** rounded off so as to avoid starting fractures on **line of inside lap.** Mr. Campbell states that all the defects he has had **with boilers he** has found on line of inside laps. He also uses welt **pieces on in**side of circular laps, and on longitudinal laps, **stay bolts 7/8" di**ameter, 4" center to center, staggered in **position; flues, 2" in** diameter; holes, 2¾" center to center. In **setting flues uses** copper ferrule in fire-box end. This boiler **has wide fire-box,** which is placed on top of frames, securing large **area of grate sur**face. The blue print "R" shows plan of frame, **with plan of** supporting boiler by suspension links and pads, **securing boiler to** frame; also plan of equalizing with springs and levers. **The prin**cipal dimensions of this locomotive are as follows:

Number pairs of drivers	2
Diameter of drivers	5 ft. 8¼ in.
Diameter of cylinders	20 inches.
Length of stroke	24 "
Weight of engine, with fire and water	97,500 lbs.
" on driving wheels, with fire and water	68,680 "
" of tender, with fire and water	54,000 "
Inside length of fire-box	129 inches.
" width of "	42½ "
" height of fire-box back 42" front	48 "
Grate area	5,482½ "
Length of combustion chamber	5 "
Diameter of boiler	54 "
Thickness of sheets—steel waist, 7/16 thick; fire-box, 3/8" thick; wagon top, 1/2" thick.	
Number of flues	220
Length	140 "
Outside diameter of flues	2 "

In conclusion your Committee would recommend **that the re**port and accompanying blue prints be printed in **the Annual** Report. Very respectfully submitted,

(Signed,) WM. WOODCOCK, C. R. R. of **N. J.**
G. W. STEVENS, L. S. & M. **S. R. R.**
A. W. SULLIVAN, I. C. R. R.

Committee on New Plans for Construction and Improvement in **Locomotives.**

On motion of Mr. Briggs, seconded by Mr. Stevens, the report was received, and the recommendation of the committee adopted.

MR. STEVENS—If I understood the reading of the report the method of lagging on the Lake Shore Road was not correctly stated, it was only applied to the lagging of such portions of the boilers as have heretofore been uncovered. I know it is not the general practice to lag the boiler head. But we do so, and also lag the outside of the fire-box.

MR. SETCHEL—It does not include that part usually covered by the wood?

MR. STEVENS—No, sir.

MR. WOODCOCK—The Committee was at a loss to know exactly in reference to that matter, but as some members had heretofore tested the asbestos we thought it might include all parts, as I have no doubt we are all trying to secure something more durable than wood, and asbestos seemed to be something in the right direction. We construed this report to the best of our knowledge. Of course, if we can lag all the exposed part of a boiler I suppose it would be a gain, but it is not usual to do so, and it is interesting to the members to know that it can be done as has been explained by the prints. I would suggest that the report be corrected as explained in that manner.

MR. STEVENS—The blue prints show quite clearly just how the lagging is applied. It is applied substantially as described in the report; that is, first a layer of asbestos, and then a layer of felt, and then a covering of iron.

MR. LOCKWOOD—I am advised that the suggestion which I am about to make is proper at this time. It is this: The Franklin Institute of Philadelphia are going to have an exhibition in September of what is termed a novelty exhibition. During the past three years there have been many recommendations and suggestions as to the question of weighing the hammer blow, believing that the blow may be weighed with the speed of location, but that it is not possible to weigh it with the speed of location combined with the speed of translation. I therefore move that a committee of five be appointed to act in conjunction with a committee of the Franklin Institute to confer and suggest plans to be tested at that time. That will be without expense to the association. I shall be glad to answer any question that any gentleman desires to ask in that connection, and also to make a brief statement in regard to some recent experiments in burning crude petroleum.

MR. SETCHEL—As the Secretary will have to make up these reports I beg to say that I think the gentleman's remarks are not in accordance with the subject before the Convention and will come very much out of place if they shall go in that way. The subject now before us is improvement in locomotive construction and not experiments in regard to fuel.

Mr. Lockwood—I am not familiar with the proceedings, but I was advi ed that this was the proper time to make the motion. However, I will withdraw it and renew it at a future time.

Mr. Swanston—There was an idea presented in that report about raising the side sheets above the level of the crown and allowing the crown-bars to rest upon them. That leaves a hollow space where mud gets in. We have several engines like that, and I would like to know whether members of the Convention have had experience with side sheets raised in that way.

Mr. Campbell—I have made them so for the last twelve years, running the side sheet above the crown sheet one inch, without any bad effects.

Mr. Sinclair—While this subject is up, I see the compound engine case spoken of in it. In order to make better use of the steam in the cylinders there are a great many of the more advanced master mechanics and mechanical engineers looking towards the compounding of the locomotives so that greater momentum will be produced. I think it is probable by employing a better valve gear that the same results as are obtained from compounding may be brought directly through the ordinary cylinders of the locomotive. There is a steamer running out of New York whose construction seems to me very interesting to those who are paying attention to this subject. The steamer Hudson, belonging to the Cromwell line, has a single cylinder, with an adaptation of a valve gear to it, which gear is such that the cut off can be made very early and held close towards the end of the stroke. With that engine they have obtained almost as good results as anything got from the compound engine. It is necessarily much simpler than the compound engine, and that is a point of great importance to locomotives. Consequently, I think it is desirable to work in that direction. When we are increasing the steam pressure continually it seems to be very necessary that a gear should be employed that will take more out of the steam than the link gear. I think for comparatively low pressure there is nothing equal to the link and its simplicity is a great recommendation to every one in charge of machinery; still, for very high pressures it is not at all a perfect gear, and I think if you can get a gear that will cut off say at three inches and expand down much nearer the atmosphere than the link can do, that you will obtain approximate results to what is got with the best compounded locomotive. Some of those drawings around on the wall show that gear of Mr. Strong's, which Mr. Mitchell of the Lehigh Valley road has recently applied to an engine, and, although the indicated cards there, do not show a very early cut off, yet there is the beauty of obtaining that by the gear in question, and consequently I think that is

the proper line of improvement for American master mechanics to follow. That subject will force itself upon the whole of you sooner or later, and the sooner you begin to study out the question and make yourselves familiar with it I think it will be the better for all interests. I merely make this suggestion as a possible line of improvement. In reference to the compound engine, there are very few who look with favor to the compound engine, but you are earnestly desiring to get a better result from steam, and I think this will be a simpler plan and that it will be quite as effective.

MR. STRONG—I am not a member of this society, but as my valve gear has been introduced before you, I should like to give my reasons for working in the line I have, and illustrate it by a scale.

THE PRESIDENT—I think you are a little out of order without permission.

MR. STEVENS—I would ask that the gentleman be allowed to state what he would like to demonstrate.

MR. STRONG—The point I wish to state was as to the possibility of expansion with the link motion, and the impossibilities of taking steam at 175 pounds and expanding it down to the atmosphere, as compared with the gear which does not alter its compression; or, by an exhaust with an early cut off on the steam.

MR. HATSWELL—I move that Mr. Strong be allowed to state his views to this Convention.

MR. BLACKWELL—I second the motion.

Carried.

You are familiar with the fact that with the link motion you can not get within ten pounds of boiler pressure as initial pressure (and often not within fifteen to twenty pounds) on fast running engines, and that the pressure will drop from the initial to the point of cut-off ten to fifteen pounds, giving at point of cut-off twenty to twenty-five pounds less than boiler pressure, which loss is due to wire drawing, which is due to inadequate opening of valve, and to short port; and that an early cut-off causes an early closing of exhaust and an excessive compression, which, with large clearances, will fill the clearance and exceed the boiler pressure, reducing the effective work on the opposite end of cylinder thirty-three per cent, all of which means a low mean effective pressure at early cut-off, so that to get an early cut-off on a link motion engine means want of power to handle a heavy train at high speed, and to handle it, it is necessary to cut off late in the stroke, which gives a high lower end or exhaust pressure, which is a

dead loss, or in other words a link motion can not be made to work high pressure steam economically with a single cylinder, hence compounding has been resorted to by some of the English and Continental railways. To overcome this difficulty and get an engine capable of working high pressure steam economically, that is, taking it at a high pressure and exhausting at a low pressure, and giving a high mean effective pressure, we have designed a locomotive, now being used for heavy work on L. V. R. R., that works its steam and exhaust entirely independently, and the exhaust works full stroke at all points of cut-off, and the steam can be varied from a 3″ cut-off to a 20″ cut-off. The steam and exhaust ports being very long, 50″ on each valve, gives full boiler pressure as initial pressure at all points of cut-off, and the fall of pressure between point of cut-off and initial pressure is not more than five pounds, which is the only loss we have from a perfect working. The exhaust opens at 22¾, and remains open until within three inches of the end on return stroke, giving 3″ compression, which is sufficient to fill the small clearances and give valve pressure at end of stroke. The actual gain by experiment over a link motion at an early point of cut-off is one hundred per cent., in power developed, and this locomotive is now doing the work of two ordinary locomotives on mountain grades, and has made 45 miles per hour up a 96 ft. grade, with a train of 200 tons, without any variation of steam from full boiler pressure, with double 4½″ nozzles.

Mr. Woodcock—I wish to refer to the extension of the side sheet above the crown sheet, for the success of which very much depends upon the character of the water. Take that style of crown sheets on roads where the water is bad, it seems to me it would probably cause trouble. So we are only to judge of these plans by the localities, and these matters are brought before the Convention for reference to show what was being done by this Association, and it is for record that we can know and judge by these reports what is being done by different roads. It is not supposed. I think that we recommend this as the only plan or the best plan, but they are brought before you for your information. It is the custom of this committee to gather up all the facts they can during the year so that each member of the Association may judge for himself what is the best plan. I will just refer again to the tracings showing the very radical departure in the construction of locomotives and boilers. I refer to the Twin fire-box, which came in rather late to be embodied in

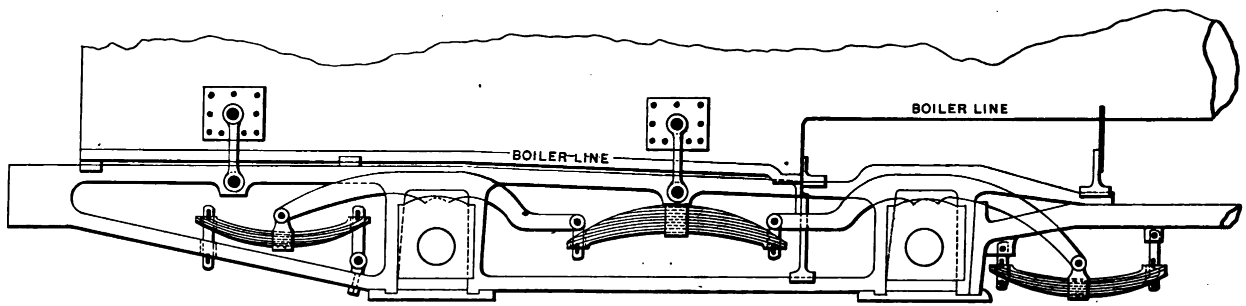


Plate 42. Arrangement of Springs for Lehigh Valley Railroad, Delano Shops.

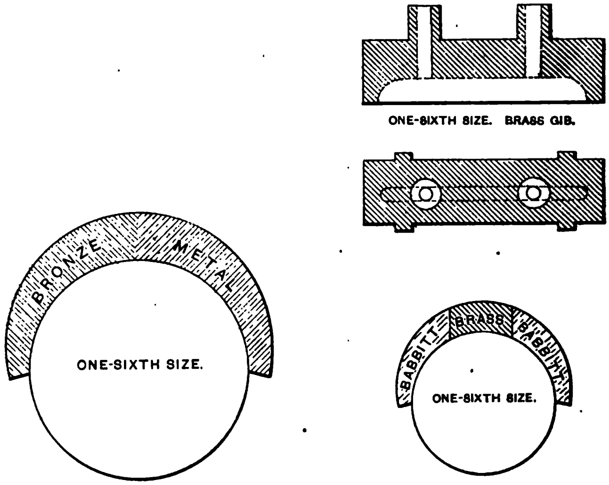


Plate 43. Lehigh Valley Railroad Driving and Truck Brass. Delano Shops. 1885.

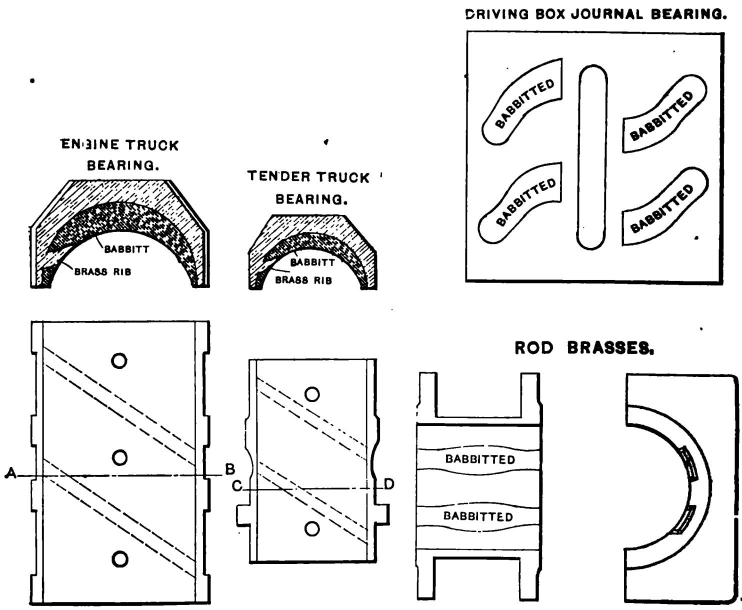


Plate 44. Wabash, St. Louis & Pacific Railroad.

our report, but which may be included before it is printed. It certainly is a very radical change and one that is worthy of investigation.

On motion of Mr. Lauder, seconded by Mr. Stevens, discussion on this report was closed.

The Secretary read the report on locomotive bearings.

FRANKFORT, N. Y., June 3rd, 1885.

To the Officers and Members of the American Railway Master Mechanics' Association:

Your Committee on the Best Metals for Locomotive Bearings would report that they issued circulars requesting information on which to base their report. They have received ten answers to their inquiries.

In answer to the first question, "What has been your experience with metals used on engine and tender journal bearings? Also on connecting rods and other parts of the locomotive," they have the following replies:

Mr. Charles Blackwell, N. & W. R. R.: "Unless care is exercised in the melting and pouring of bearing metal, very different results are obtained."

Mr. John Campbell, L. V. R. R.: "Using all bronze metal bearings for locomotives except under engine truck, for four or five years. The engine truck bearing is a brass gib on top with babbitt on each side, as shown on Plate 43."

Mr. J. S. Graham, Buff. Div. L. S. & M. S. R. R.: "Experience has been limited."

Mr. Jacob Johann, W., St. L. & P. R. R.: "Soft metal bearings for engine and tender journals and babbitt strips in rod and driving box brasses, are economical and satisfactory in their operation." (Plate 44.)

Mr. William Woodcock, C. R. R. of N. J.: "Journal bearings made of best copper and tin in proper proportions, give the most satisfactory results. Have used a soft metal that produced exceptional wear and mileage, but it could not be relied on under all circumstances, as in case of a hot journal the metal of bearing would crush or break in pieces. Have had a number of these bearings to run 90,000 miles on journals 3½" x 7" under passenger coaches, and remain in service until completely worn out. Believe if this metal were encased in a brass shell of proper strength to

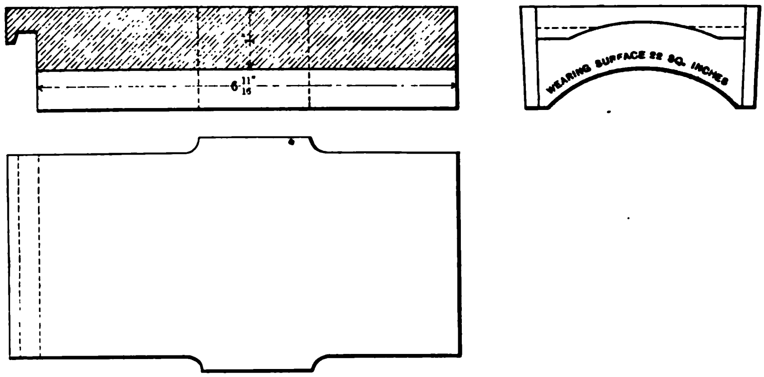
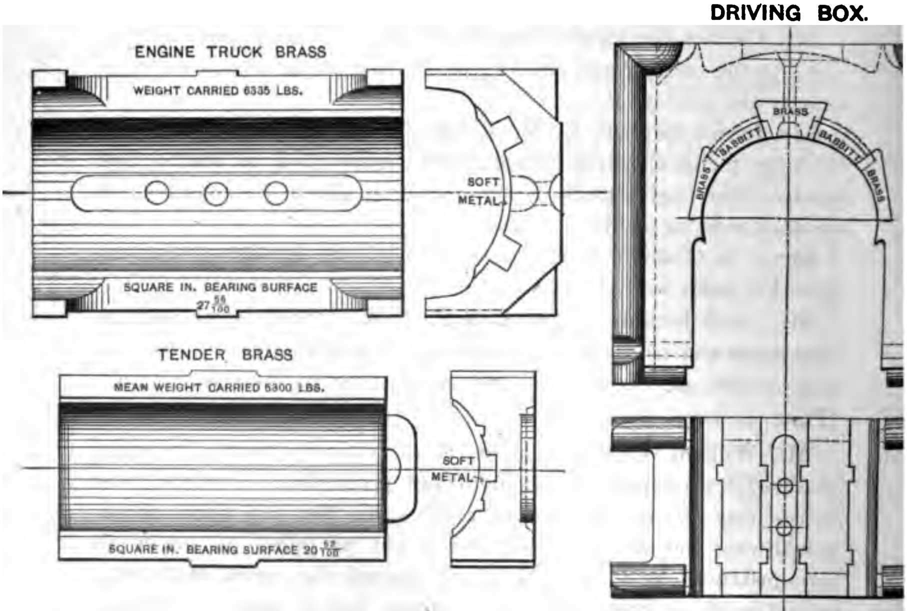


Plate 45. Standard 3½x7 Journal Central of New Jersey.

DRIVING BOX.



SCALE ½ IN.=1 INCH

SCALE ½ IN.=1 IN.

Plate 46. Engine and Tender Bearings Lake Shore & Michigan Southern.

sustain the weight, it could be used with very good results and increased mileage over the use of brass alone." (Plate 44.)

Mr. Geo. W. Stevens, L. S. & M. S. R. R.: "Use engine and tender bearings and connecting rod bearings made from old material. The composition is about one of tin to five of copper, and one of tin to seven of copper." (Plate 46.)

Mr. William Montgomery, P. & R. R. R.: "Use brass with babbitt metal. No new features."

In answer to the second question, "Have you used journals lined with lead or any other soft metal? If so, with what results? Please give composition of metal other than lead. Also sketch showing shape and dimensions of bearing; number of square inches of bearing surface; weight carried on journal, and kind of lubricant used. Give weight of bearing when first put in and loss of weight to each 1000 miles run. Also length and diameter of journal and loss in diameter from wear," they have the following replies:

Mr. Charles Blackwell: "Hard brass with babbitt, gives very excellent results."

Mr. John Campbell: "Have used lead lined bearings with good results," but gives no record of their performance.

Mr. J. S. Graham: "Have used lead lined bearings with good results. Also with an alloy of lead 80 parts; tin 10 parts, and antimony 10 parts, which is preferable to lead, not being pressed out of place as readily as lead and standing a higher degree of heat before melting. Tracing herewith showing plan of tender journals that are giving good results."

Weight of brass or journal	11 lbs. 6 oz.
Maximum weight on same	8000 lbs.
Square inches of bearing surface	21.
Lubricant, "Galena engine oil,"	
Loss of brass per 1000 miles run	8.29 drams.
Loss of bearing (iron) per 1000 miles run	.00059" in diameter.
Length of journal	7 inches.
Diameter of journal	3.75 inches.

"This is from a test of oils recently made, with solid 'ajax metal' journals not lined with soft metal, to insure that loss shall be from friction only instead of in part soft metal pressing out."

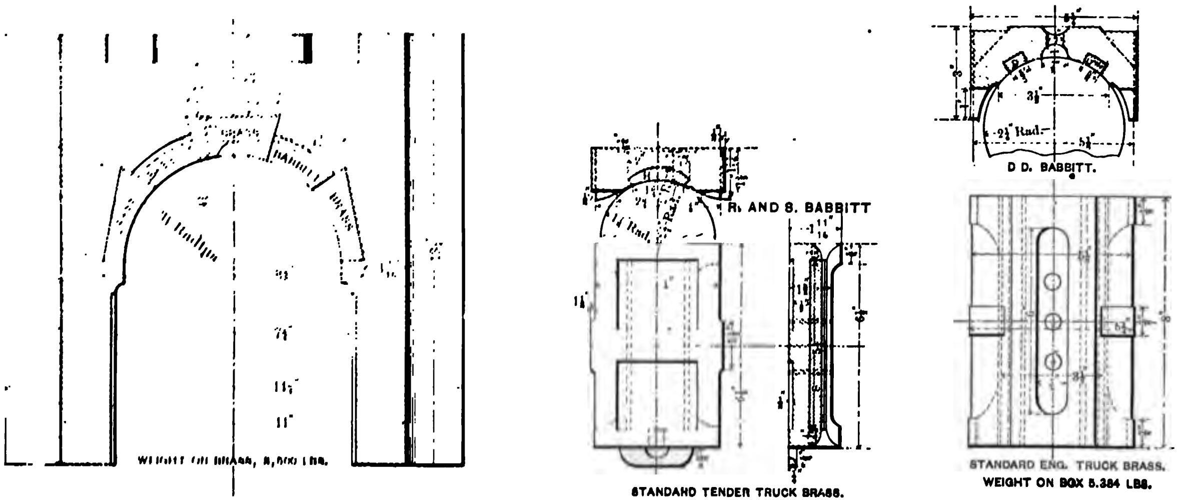


Plate 47. Standard Bearings Lake Shore & Michigan Southern, Buffalo Shop.

Mr. Jacob Johann: "Use a half shell with babbitt bearings for both engine and tender bearings as shown in drawings sent, Plate 44, both with and without babbitt, which will show method of using. The composition of the babbitt is, if the lead is soft, 4 parts of lead to 1 of antimony. If lead is hard, 5 parts of lead and 1 of antimony. For the shells, 9 of copper to 1 of tin. Engine truck journals which are 5″ in diameter and 9″ long, with bearing surface of 54 square inches, with an average weight on each journal of 7000 lbs."

"Tender truck journals 3¾″ in diameter and 7″ long, bearing surface of 26 square inches, with an average weight on each journal of 8000 lbs. Weight of engine truck shell is 17 lbs., weighing with babbitt 24 lbs. Method of construction shown in sketch, Plate 44. Weight of tender truck shell is 6 lbs., weighing with babbitt 9 lbs.; this is also shown on sketch. No experiments have been made as to the loss of weight of journal or bearing by wear."

Mr. William Woodcock: "Have used lead lined journals with satisfactory results, especially on worn journals. Use them under passenger coaches, the journals of which have been worn hollow by service. On worn axles the lead lined bearing will adjust itself to the irregularities without fitting, which would be necessary with solid bearings. The Standard bearings for passenger coaches and tender trucks will weigh 8½ lbs. The metal is 6 lbs. of copper to 1 lb. of tin; will average 40,000 miles with a loss of 59-1000 lbs. per 1000 miles run.

"The wear of journals 3½″x7″ is about 5-16″ in diameter; number of square inches of bearing surface, 22″; tracing of bearing herewith." Plate 45.

"For driving shaft bearings use the same metal as above without babbitt; tracing of driving box herewith; these boxes give very good results when properly fitted up; we recently took out a set of (6) boxes from a ten wheel engine in freight service. Weight on drivers 68,000 lb.; journals 6½″x8″; cast iron box. Composition of bearings, 5 of copper to 1 of tin; mileage, 116,869 miles; average wear of brasses, 5-32 of an inch, exceeding 46,000 miles to 1-16 of an inch. On heavy passenger engines the wear of brasses will average about 8,000 miles per 1-16″."

Mr. Geo. W. Stevens: "Have used lead lined bearings with good results; also with an alloy of 80 parts of lead, 10 parts of tin,

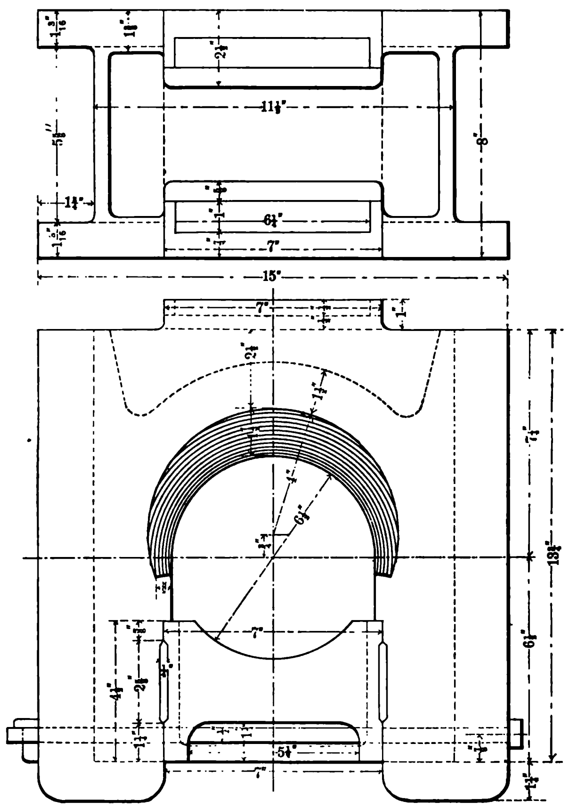


Plate 48. Standard Driving Box Central of New Jersey.

and 10 parts of antimony; blue print herewith, showing engine and tender truck brasses, Plate 44. Lubricant used, black oil. Bearings weighed when put in, $11\frac{1}{2}$ lbs., average weight lost for each 1000 miles run about 1 oz.; journals $3\frac{3}{4}''$x $7''$; no perceptible loss in diameter by wear."

Mr. W. I. Brokaw, W., St. L. & P. R. R.: "Use babbitt in about everything; allow the babbitt to project about 1-16" so it will wear down to bearing."

Mr. F. G. Brownell, B. & L. R. R.: "Prefer the common brass bearing with thin lead lining."

In answer to the third question, "Have you knowledge of any composition that answers the same purpose as 'babbitt metal' in connecting rods, &c., that requires a higher degree of heat to melt from friction, than 'babbitt'? If so, please give composition," they have the following replies:

Mr. Chas. Blackwell: "Do not use babbitt in connecting rods."

Mr. J. S. Graham: "I do not know the degree of heat required to melt babbitt metal, but from the original formula (tin 96, antimony 8, and copper 4) I should suppose any of the babbitt metals (so called) in use now-a-days, would not be inferior in non-melting qualities."

Mr. Jacob Johann: "Have not used other metal than brass and babbitt for connecting rods, except a steel bushing, with which the result was disastrous. Do not think that babbitt can be satisfactorily substituted by a metal that will require a higher degree of heat to melt from friction without using a higher grade of lubricant and a more costly one than now in general use. If phosphor-bronze is, as claimed, a partial lubricant, it might prove to be a good substitute; have never tried it."

In answer to the fourth question, "what kind of metal in your experience, has given the best results for driving shaft, engine truck, and tender journal bearings? If an alloy, please give composition, dimension and shape of same; also method of fitting bearings in the cast-iron box or shell," they have the following replies:

Mr. John Campbell: "Use bronze metal bearings for driving boxes, as shown on print."

Mr. J. S. Graham: "Have known an alloy of 85 of copper and 15 of tin to give good results, and without a competitive test, know

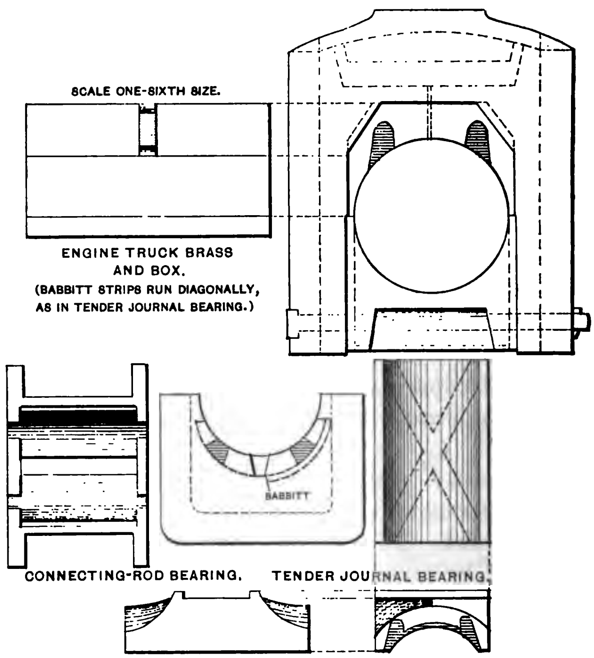


Plate 49. Standard Bearings New Jersey Southern.

of none better. Use, in tender truck journals and driving boxes, gibs, filling in on sides with an alloy of 5 of zinc to 1 of tin; am not sure of the anti-friction qualities of this alloy as compared with other metals, but it requires a higher degree of heat to melt it, and it seems to answer in other respects. Tracing shows method of construction."

Mr. Jacob Johann: "Use for driving boxes, 6 parts of copper to 1 of tin. Sketch herewith showing manner of babbitting."

Mr. William Montgomery: "Prefer good tough brass for driving and truck boxes; composition, 2 parts tin, 10 copper, and 1 zinc."

In answer to the fifth question, "Have you found the inserting of babbitt metal in journals, an advantage? If so, to what extent. Please explain method of inserting," they have the following replies:

Mr. Chas. Blackwell: "Experiments give contradictory results."

Mr. John Campbell: "Use a brass gib on top and babbitt on both sides."

Mr. J. S. Graham: "Have found the insertion of babbitt metal useful."

Mr. Jacob Johann: "Have found the insertion of babbitt metal in journal bearings to be beneficial; they get a bearing quicker with less liability to heat, and have a less wearing effect on the journal."

Mr. W. I. Brokaw: "Use a composition of 4½ to 5 parts of lead to 1 of antimony.

Mr. William Montgomery: "Believe the use of babbitt to be an advantage."

In answer to the sixth question, "What metal have you found to give the best results for connecting and parallel rod bearings? What advantage, if any, is there in a solid bushing instead of the square bearing fitted in straps? Is babbitt a benefit or otherwise, in connecting rods, and how should it be inserted," they have the following replies:

Mr. Chas. Blackwell: "Hard brass gives the best results; solid bushings preferred, if sufficient pin dimensions are admissable; simplicity and freedom from tampering with by enginemen are their chief advantages."

Mr. John Campbell: "Bronze metal bearings for connecting

and parallel rods give the best results; do not consider babbitt a benefit; do not use solid bushings; all square bearings fitted in straps.

Mr. J. S. Graham: "Have known good results from an alloy with a zinc basis, one not easy to melt, zinc 4 or 5, to 1 of tin; prefer tin, but have used with success tin 6, antimony 1, and copper 2 oz."

"The apparent advantage of solid bushings in parallel rods is, less fitted parts, therefore less labor and expense in construction; less number of parts subject to breakage, wearing part the bushing only, therefore more easily, cheaply, and quickly repaired than when bolts, keys and straps require renewal; also insurance against being thrown out of adjustment by careless keying."

Mr. Jacob Johann: "For connecting and parallel rod bearings, use a babbitted brass, as shown in sketch. For rod brass, the composition is 7 parts of copper to 1 of tin; believe that babbitted brasses for the purpose in question, have proved the most satisfactory both as to economy and practical application."

Mr. William Woodcock: "In connecting and parallel rods use all strap rods, square bearings with good results; use babbitt metal in all rod bearings of brass, except at front end of connecting rod at cross-head. The metal is inserted in diagonal strips ½" wide; have used phosphor-bronze in rods with good results; with this metal no babbitt is used. The parallel rod brasses frequently run 90,000 miles on an average, without being taken down to close up. The straps should be keyed solidly together and let alone."

"These statements refer to passenger engines running 150 miles per day. Herewith are tracings of parallel rods."

Mr. Geo. W. Stevens: "The advantages of bushed parallel rods are less fitting of parts, less expense, less parts subject to breakage, less cost of renewals. Have found babbitt a benefit in main and connecting rod bearings."

Your Committee regret that more information was not received. The subject is an important, and at the same time a difficult one to determine what is "the best metal for locomotive bearings." The conditions of service are ever changing. The questions of speed, weight, proportion of parts, rigidity or flexibility of same, lubricant and condition of track are all important factors to be taken into consideration.

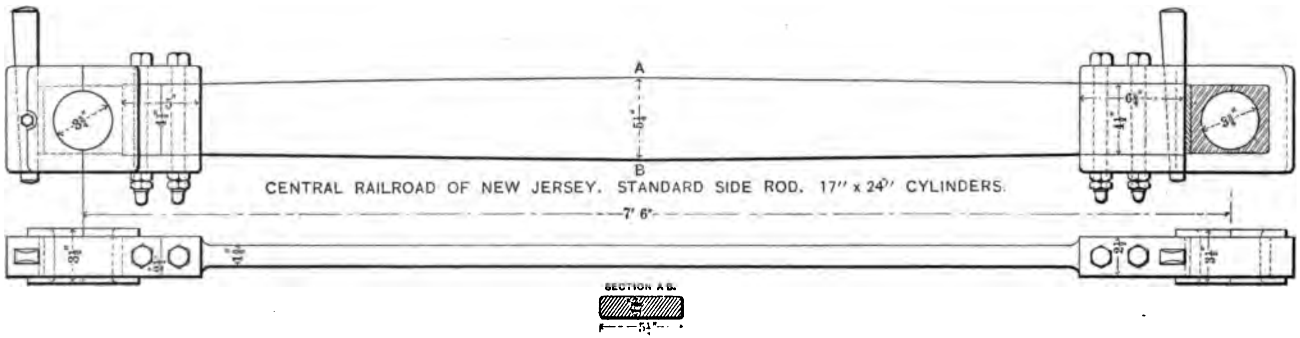


Plate 50. Standard Side Rod Central of New Jersey.

Your Committee will recommend that the members of the association give this matter special attention and make careful experiments to ascertain which of the different metals and alloys gives the best results as to wear of bearings. Also of the journals to which they are applied, and to the quality and quantity of the lubricant to produce the best results. Also to determine whether or not the advantages claimed for lead lined bearings in freedom from heating and fitting badly worn journals, is not offset by the more rapid wear of the journal, reducing it in a short time to unsafe diameter.

The question of solid bushings in the ends of connecting rods, is also one that should be more closely entered into. The claim for reduced cost of making and keeping in repair over the old style of rods with straps and keys, has not been demonstrated by figures obtained from actual results. If it has been, your Committee have not been able to obtain such figures.

JAS. M. BOON,
J. I. GRAHAM,
J. P. HOVEY,
Committee.

MR. SETCHEL—Mr. James Meehan is present, and I believe he uses solid brasses in his rods to a greater extent perhaps than any one present, using them in the front end of the rod even. I would like to hear from him in regard to the matter.

MR. MEEHAN—I am unaccustomed to talking in public, but I will tell you what I know about the matter. We have eight passenger engines with solid rods at the back end of the main rod, and side rods. They have been in service about two years, and have given us no trouble. Engine No. 182 has made 110,000 miles, and has never had a rod down. She is now in the shop for the purpose of having her tires turned, and when she goes out the rods are to be put on again in the same condition, not having been touched. The others we did not have quite as good results from. It only takes about three hours to renew them. We pres, them in at twenty tons. I think the solid rod is much the cheapest though I am not prepared to recommend it on the front end of rods. For side rods I would have nothing else.

MR. BLACKWELL, of the Norfolk & Western and Shenandoah Valley road—We had about forty engines equipped with solid bushed side rods. They have given us very excellent results, but I would not recommend bushings being used of this character unless sufficient pin dimensions are given. If an ordinary pin is used a solid bush is sure to give trouble,

as it has not sufficient surface to insure length of service. When you have sufficient bearing surface it works extremely well.

MR. MCCRUM—I would state in this connection that I have between forty and fifty locomotives equipped with the solid bushing that have been running, extending over a period of five or six years. My practice and experience has been entirely satisfactory, much more so than with the use of adjustable brasses. I had two or three different forms of fitting; but as I have nothing to illustrate with, this is all the information I can give on the subject.

MR. BLACKWELL—The smallest dimensions of pins that I like to use solid bush with is about four and a half inches in diameter and four in length. I have used different metals for bushings, but I prefer good hard brass. I have used phosphor bronze, and I find that although it runs cool it becomes loose more easily than hard brass.

MR. SPRAGUE—I would like to ask what is the experience of members who are babbitting rod brasses, whether they cast the recesses for the babbitt, or drill them. I think it is best to drill them. You can drill them cheaper, and you are free from any scale or dirt in your babbitt. I have often found that when the recesses were not thoroughly cleaned that the sand would be liable to cut the journals.

MR. BLACKWELL—If Mr. Shaver of the Pennsylvania road is here he might be able to give us his experience wi h solid bushings.

MR. SHAVER—We have one powerful engine that uses solid bushes in her side rods and she works very satisfactory.

On motion of Mr. Johann, seconded by Mr. Hatswell, the discussion on this subject was closed.

THE PRESIDENT—The next report is that upon steel casting for locomotives. Before that is read, however, we will give the members who have not paid their dues an opportunity of doing so.

After a recess of five minutes was taken, the President said, is the Committee on Nomination of Officers prepared to report?

MR. LAUDER—Yes, sir; and their report is in the hands of the Secretary.

MR. SETCHEL—The report of the Committee on Nomination of Officers is as follows:

For President, J. Davis Barnett; for Vice-President, William Woodcock; for Second Vice-President, Jacob Johann, J. F. Devine, George H. Colby, and R. H. Briggs; for Secretary, J. H. Setchel; for Treasurer, George Richards; for Member of Committee on Subject, Charles Blackwell.

On motion of Mr. Shaver, seconded by Mr. Stevens, the report was received.

MR. FORNEY—Would new business be in order at the present time?

THE CHAIRMAN—Not at present.

MR. SETCHEL—I have only one report, Mr. Forney, and then new business comes.

MR. FORNEY—I only asked at this time, because I must get away this afternoon.

MR. SETCHEL—The report of the Committee on Steel Castings for Locomotive Work is as follows:

REPORT OF COMMITTEE ON STEEL CASTINGS FOR LOCOMOTIVE WORK.

Your Committee to whom was referred the subject of "steel castings for locomotive work," would report that they issued through the Secretary the following circular of enquiry to all the members of the Association:

"*To the Members of the American Railway Master Mechanics' Association:*

1st. Have you had any experience with steel castings for locomotive work? If so please say to what extent.

2nd. Do you believe that steel castings can be used satisfactorily as a substitute for iron?

3rd. Does your experience with steel castings lead you to believe that the material is reliable under all circumstances?

4th. What part of a locomotive do you consider steel castings best adapted for?

5th. Taking into consideration the first cost of steel castings, how does the service got from them compare in cost with the service got from iron?

The Committee will gladly receive any additional information on the above subject you may have to communicate."

To this circular the Committee received only fourteen replies. Although the information elicited was more meagre than your Committee had reason to expect, it was obtained from master mechanics in all sections of the country and may be accepted as representing fairly the experience of the members with steel castings for locomotive work. Several of those who sent in replies had very limited experience with crucible steel, but the general impression was that for the purposes to which they have been applied, castings of this material are much more reliable than cast iron but not so reliable as wrought iron. To this conclusion there was one decided exception, one member having expressed the opinion that steel castings were preferable to cast or wrought iron for general work.

Most of the members heard from have applied steel castings for cross heads only, and all of them with this experience reported for that purpose the material is quite reliable.

One member only reported as using crucible steel driving boxes, one uses link hangers, one eccentrics and two rocker arms made of crucible steel.

All the members who sent in replies are agreed that steel castings are more economical than iron where they can be used advantageously. The economy of substituting steel castings for cast iron arises from the superior strength and durability of the former over the latter; while the benefit of using steel castings to replace wrought iron is gained in saving the labor of making forgings.

As steel castings can be put exactly into the forms required a great deal of machine work is often avoided by their application to locomotive work.

In replying to the circular, Mr. J. Davis Barnett displayed an intimate and wide acquaintance with the subject of crucible steel castings, and your Committee quote the following from his reply:

"They (steel castings) are being substituted in marine work very rapidly and with success. Where it is an object to save weight, as it is in reciprocating parts more particularly, and yet retain strength they should be used." Answering query 3 he says: "Yes if crucible steel is used and the price is paid; for as Emerson said 'cinder in the iron often means cinder in the price,' and for so fine a material must be paid a good price, but the increased demand will soon lower the price."

A German firm this year (1884) have been delivering crucible castings, sound, well finished and very free from blow holes at the same price as castings by local firms using the cheaper and less reliable process of Bessemer and Siemens, cost by the ton being about 4½ cts. per pound or perhaps 5 cts. for small work; whereas on this continent I doubt if satisfactory contracts have yet been made much less than 7½ cts per pound and I think 9 or 10 cts has been asked.

Steel castings will yet be used for connecting rods and piston heads, thus lessening the weight of the reciprocating parts requiring to be balanced, and permitting length of cylinders to be shortened.

Mr. Webb of the London and North Western Railway is now

casting Bessemer driving wheels in a revolving mould thus condensing the metal; but the rim and spokes are fashioned after the style of the forged wrought iron wheel, that is they are solid, whereas less metal for the same strength could be obtained if the American hollow system were followed. The hollow column is nature's system and she is chary in the use of material as the examination of a limb bone, or a length of wheat stalk will show. The rocker and reversing shafts should be cast hollow keeping at about their present diameter; the arms should be ribbed. Eccentric shieves, straps and rods with link blocks and all its connections may be of steel, with advantage to the weight, and in the substitution of castings for smiths' work in such small things as bell cranks, throttle levers, door and injector fittings as well as rocker and reversing shafts, the first cost of manufacture as well as of machine work will be lessened, as fewer surfaces will need machinery, and those few require less metal to be removed from them."

Your Committee are aware that when steel castings were first introduced with general machine work, they were not found reliable in numerous cases, and many parties abandoned their use after trial. We have reason to believe that the failures were due to a great extent to the inferior work produced in the first stages of a new industry and that many who abandoned steel castings after the first trial have returned to using them with satisfactory results. In many departments of machine work throughout the country, steel castings are being rapidly substituted for expensive forgings. We see no reason why this material should not be applied to all the details of locomotive work as recommended by Mr. Barnett, and we think also that it might be applied to the making of cylinders, driving wheels and other parts where increased strength would mean increased durability. The high price of good steel castings is at present an obstacle to their adoption for ordinary purposes, but we believe the law of competition is working to reduce this price and that it will soon be cheaper all things considered to use crucible steel than to use cast iron for many purposes about locomotive work.

There has appeared in some of the leading mechanical journals, lately articles describing the making of steel castings from old rails and other steel scrap by a process where a common cupola was

used to do the melting. Most of the members have probably read the articles. Your Committee have received no direct information about this new process but they think that it may prove of great value to railroad companies and that it deserves investigation by the members of this Association.

R. W. BUSHNELL.
THOS. J. HATSWELL.
JOHN BLACK.

On motion of Mr. Sprague, seconded by Mr. Lauder, the report was received.

MR. SPRAGUE—Are any members using cast steel cross heads for a wearing surface? If so, what is the result? I would like to know whether it compares favorably with cast iron for wearing surface.

MR. LAUDER—I came here hoping to get some information in regard to the use of steel castings on locomotive work. While I believe that in the near future we shall be able to substitute steel castings—preferably crucible steel—for many of the parts now made of wrought iron, there are some things that I would not use it for until further investigation. The parts I refer to are those having wearing surfaces. I think it will be found that castings made from cast steel—not cast iron castings with a skin of surface converted into steel—I think it will be difficult to make those wearing surfaces wear as well as cast iron. I presume nearly every road in the country has more or less cross heads running that are called cast steel, which is made in Chester. Those castings are not cast steel. If you will plane off from one-eighth to half an inch you will run into the cast iron. I don't mean to condemn them, because they give excellent results, and I think they are preferable to cast steel. A cast steel cross head will not run in any guide that I ever saw. I have engines with imported cast steel cross heads, and I could not make them run. A man might sit on the front of the engine and pour oil on those cross heads and they would cut. They were running in cast iron guides, by the way. and I was obliged to spread the guides a little and put on cast iron gibs, and then they ran beautifully. You must not attempt to run the cast steel casting without having something on it for a lining or wearing surface, because it will be folly unless you do this. I have been met in that position by the argument that cast iron cross heads run in cast steel guides. They could see no reasons why they should not run in cast iron guides. I simply say that the first statement is not true; that cast iron cross heads will not run well in steel guides. They will run, of course, but with an enormous amount of difficulty. So I think running cast steel if it is steel—on cast steel, or wrought iron, or on bronze, will be found a very difficult operation. The report mentions the advisability of using cast steel eccentrics and straps. While I have never used them, my

judgment would be that it would be very difficult to do it. I think the surfaces would cut. I think they would give trouble in heating and cutting. I presume all of us know, that in the early days, wrought iron was used for eccentric straps, and there was difficulty in that direction. Then brass was substituted. Perhaps, all of our older members have had experience with brass as eccentric straps. It made a soft strong material and wore rapidly. When we got the cast iron the difficulties all seemed to be cured. I doubt whether we will ever get a material that will run as well as cast iron for eccentrics and straps. We are obliged to use something better, and wrought iron forgings being expensive we are forced—and I hope we shall all be forced—to use steel, but if it is used, I should recommend the wearing surfaces to be protected by some other material, that will give a better wearing surface.

MR. JOHANN—I have gone through precisely the same experience that Mr. Lauder has. I have tried to run cast steel cross heads on cast iron guides but was not successful and finally had to plane them down. I used cast iron linings in place of bronze. I have also used cast steel rocker arms, as I supposed, for some time with success, but in the course of time, difficulties presented themselves which led me to abandon that, and that is, that the cast steel rocker arm wore very much faster, so much so that it was annoying and we finally abandoned them. I did not go into any experimenting to see why that was so, but that was the fact, and we simply abandoned it. I believe that up to this time they have not really yet perfected their cast steel castings; so that we really can get very good results from them. But I believe the time will come when we can use them, because people will naturally experiment and perfect their castings more than heretofore. I think it is desirable and practicable to use cast steel castings wherever we can get them of the proper composition.

MR. LAUDER—Lest there should be misconstruction of my remarks, I will say that I do not wish to be understood as condemning these castings made at Chester. I simply say that they are not in any proper sense cast steel, but I endorse them fully as a proper material to make cross heads out of. I have run them several years with good results and never broke one. I make this explanation in justice to the Chester people. If they were cast steel I do not think they would run as well as they do. Their wearing surfaces act very much as cast iron.

MR. BROWNELL—I would say for the members of the Association that I have been running both iron and steel eccentrics. The eccentric cuts the strap out. I have two steel eccentrics, one on each engine, with a cast iron strap, and there is a continual cut all the time on the strap.

MR. EASTMAN—I would ask Mr. Lauder why he recommends cast steel cross heads and the using of cast iron cross heads when he admits

that we get good results from the Chester steel. I never saw such good results with cross heads as I have seen with the Chester steel. I have an engine that has been running over four years on which it would be difficult to insert a common piece of lining iron between the slides and the cross heads, and our road is ballasted with fine ballast and is very dusty. There are four other engines that have been running two years and a half on which the guides have not been touched. I admit that the bearings are long, and the guides are extremely wide—four and a half inches—which gives them a large bearing surface; but they have not cut and have required no attention.

MR. LAUDER—In reply I would say that I would recommend the cast steel owing to its increased strength. To be sure, I have heard of Chester cross heads having broken though I have not had any broken myself; but the material is so near cast iron, and yet so much of it is in fact cast steel, that I think it would give a very much increased strength.

MR. HATSWELL—I would like to ask what style of guide Mr. Eastman is using, and if he uses a solid steel bearing on the guide, and would also inquire whether he inserts any babbitt or any other metal in the cross head.

MR. EASTMAM—The cross heads are solid cast steel. The guides are cast iron without any babbitt or other metals at all. In reference to the engine that has been running four years, the guides are only three inches wide. The cross head is 17 inches long. But on the other engines the guides are wider—I think the bearing is four and a half inches. There are four guide bars.

MR. HATSWELL—The reason I asked the question was that we have experienced the same trouble in running steel that Mr. Lauder speaks of. I have tried a steel cross head on an ordinary steel guide with very poor success, and I have tried a wrought iron guide with the same result. I have used steel bearings on a cross head on a steel guide and on an iron guide with no success whatever.

MR. LAUDER—I think Mr. Hatswell would find it to be economical to throw away all of his case hardened guides, whether of steel or iron, and substitute plain cast iron. If he never used them he would be astonished how much better they run than a steel or a wrought iron case hardened guide. I would not take as a gift the best set of case hardened guides that was ever made if I could get cast iron.

MR. FINLEY—I would like to ask Mr. Lauder if he does not find it necessary to increase the strength of his cast iron guide over that of the other material.

MR. LAUDER—I should say emphatically no. We find that substituting cast iron guides for steel or wrought iron, provided the wrought iron and steel is a suitable thickness, it is a much more suitable material.

MR. MCCRUM—Some years ago I tried steel cross heads on steel guides and I could not make them run at all. I afterwards substituted cast iron gibs with babbitt. In regard to the cast iron guide, my experience has been similar to that of Mr. Lauder. I used a good many of them and consider them the best wearing guide I have ever used. I have some that perhaps are not heavier than steel guides, but ordinarily we make them a little heavier. I have never had any broken except in accidents. I think that if you get good close grained cast iron you will probably obtain better results than with almost any other metal you can use for that purpose.

MR. STEWART—My experience in the use of cast steel cross heads and cast iron guides and cast iron rocker arms had been somewhat different from some of our friends that have spoken. I have been using Pittsburgh steel and crucible steel on a cast iron guide for about thirteen months, and I must say that we have had no trouble whatever. Engines that have been in service during that time—two in particular—that have been hauling our heaviest passenger trains, making 143 miles a day show no perceptible wear of the slide or cross head. Of course, you will see that we have no trouble with cutting. If we had, they would have shown the wear. In relation to the strength of a guide, I suppose it would be necessary to make them a little stronger putting on cast iron than the ordinary wrought iron or steel slides. Consequently, when I put them on, I made them one and a quarter at the ends and two and a quarter at the center. We have had no trouble with breakage. In regard to cast steel rocker arms I would say that those two engines that have been in service thirteen months show no perceptible wear. My experience has been, with regard to most all wearing surfaces, that a good careful engineer who looks thoroughly after his oiling is about as good a substitute for a wearing surface as anything we can get. [Applause.]

MR. SETCHEL—I have been favorably impressed with the idea of steel castings for some years, but haven't had an opportunity to put it in practice until within the last three years. Before deciding to use them in any part of the locomotive, I made inquiry and I found that some roads had steel driving boxes that had been running six or seven years and gave the very best result, being freer from liability to break, and the wearing surfaces remaining perfectly smooth. So in ordering some new engines, it was decided that we would use steel driving boxes, and, without any brand of steel being specified, steel driving boxes were actually used. That is they were steel; they were not decarbonized iron, but they were steel; they could be drawn out and made into a cold chisel. Well we found out from the start that steel of that kind would not wear against any rubbing surface. It would not wear against the

hub of a driving wheel any distance, not if you tied a can of oil over the top; and I am satisfied that practically this is the case where there is any liability to wear. There may be roads that are very straight where a driving box of this metal may be made to run for a short time, but I am satisfied it will finally result as it has done with the use of cross heads. Sometimes a cross head made of this quality of steel can be made to run a short time, but you will soon nave to incase it in brass or some other metal. The result was that we had to line the hubs of our driving wheels in order to make them run with this steel. While I believe that the Chester steel will do good service, I believe that the better quality of steel will not run against a wearing surface. In the use of driving boxes it seems to me that the only proper method is to use brass of the very best quality, made solid without any insertion of liners. Some twelve or thirteen years ago I built two ten wheel engines and fitted them up with solid brass driving boxes and brass wedges. The brass wedges and box together wore fast, but with the substitution of iron for wedges, and brass for boxes I believe that you get the best form of metal and the best kind of a driving box for locomotive service. I have never seen any cross heads on any roads made of steel but what in a very short time they had to be encased with brass.

MR. WHITNEY—Some ten or twelve years ago we had fifteen engines with steel cross heads and steel guide bars, and we always had trouble with them. We had to plane them down and put in brass gibs before they would run satisfactorily. Several years ago we had some new engines built, and the builder thought he would improve on our specification and give us cast steel. I happened to be in his shop one day, and I told him not to put them in, and I made him give us cast iron. But with cast steel pistons I must say we have been very successful.

A recess of ten minutes was taken at this point for the purpose of enabling a photographer to photograph the Convention.

THE PRESIDENT—It being now twelve o'clock, the hour which is usually devoted to discussion on general subjects, and the Secretary having told me that no questions have been sent in I would suggest that we proceed right on with our regular order of business.

MR. JOHANN—I have a resolution here in reference to a matter which has provoked some discussion, being in reference to papers presented to the Association by outside parties.

THE PRESIDENT—We have two reports yet to read, Mr. Johann, and I think that resolution of yours would come in more properly under the head of new business.

MR. LAUDER—I suppose this Association is a law unto itself and can by unanimous consent abrogate its own rules. I have here a matter of considerable importance, which was entrusted to me by Mr. Forney

whom you all know would not bring a matter here except it was of great importance. He is necessarily absent, and I therefore ask unanimous consent to have it considered at this time.

MR. BRIGGS—I move that Mr. Lauder be accorded the floor.

MR. JOHANN—I second the motion.

Carried.

MR. LAUDER—I have a letter here from Prof. Baird, addressed to Mr. J. E. Watkins, as follows:

UNITED STATES NATIONAL MUSEUM,
UNDER DIRECTION OF
THE SMITHSONIAN INSTITUTION,

WASHINGTON, JUNE 20, 1885.

Mr. J. H. Setchel, Secretary American Railway Master Mechanics' Association:

MY DEAR SIR:—I beg leave to call your attention to the following letter:

To whom it may concern:

Mr. J. E. Watkins, of Camden, New Jersey, has been appointed Honorary Curator of the Section of Steam Transportation (Railways and Steamboats) in the United States National Museum.

Mr. Watkins is authorized to treat in the interests of the National Museum with any persons who may be willing to aid in the development of this section, and to add to the collection already in the Museum, objects illustrative of the history and growth of this industry in the United States. Specimens thus acquired will be exhibited in the Museum in the name of the donor.

(Signed) SPENCER F. BAIRD,
Secretary Smithsonian Institution, and
Director U. S. National Museum.

What I want this Convention to do is to permit Mr. Watkins about three minutes talk, simply to place before the Association the notice of the National Museum in regard to collecting information as to the history of railroads and steamboats of this country, a question that I think every man will see is of a great deal of importance.

On motion of Mr. Johann, seconded by Mr. Briggs, Mr. Watkins was invited to address the Convention.

MR. J. E. WATKINS—I thank you for this privilege. In looking over the different exhibits which have been placed in the National Museum we find that there is a nucleus of a collection which may be made very instructive and interesting to those who visit Washington. Every year

since the Museum has been opened there has been an increased attendance, and it has been decided to construct an annex in which shall be placed relics in regard to the early railway history of America. You know that the system there is to show the evolution of the subject from the beginning, and they want to do the same thing in regard to railway matters. The Pennsylvania railroad has presented the Museum with the first locomotive, which was the old "John Bull," which ran upon the old Camden and Amboy Railroad. While it is not the oldest locomotive in the country, it is the oldest ever run by the Pennsylvania company. They also have been presented with enough track of the rail of the first road designed by Robert Stevens in 1831, which was the first road designed for rolling trains. Now, there is a great deal of material in existence, I understand, which would help to swell this kind of a collection, and there are a great many master mechanics who have relics which exhibit the early ideas and thoughts on these questions. It is the desire of the authorities to make this a question of National importance, and not merely one in which a single road is interested. I only received my appointment on Saturday, and consequently I have not had time to prepare any list or programme of what is wanted, or what we intend to do. Old Mr. Isaac Dripps, who was the first master mechanic, had expected to accompany me here to-day but he was taken ill on Monday and was therefore unable to come. I want to feel that as a railway employee, which I am and have been for fourteen years, that I can have the co-operation of this Association. I feel that now is the most auspicious time for beginning. The old men who, half a century ago were interested in railway mechanism, are passing away. I should be very glad to hear from any members of this Association in regard to the matter, and to obtain from them any authentic accounts or relics, duplicates of relics, or of drawings, or of old ideas in connection with the locomotive, the passenger cars and the freight car. In fact, in regard to the car we have more difficulty in showing its evolution than with anything else. There are so many ideas in connection with it at the same time that it is almost impossible to show how it was made perfect step by step. I have had my attention called to that matter particularly by making inquiries of some of my friends who visited the New Orleans exposition. I don't think that any one failed to tell me that the Pullman Company made a very fine exhibit. We will begin it in an humble way with a small annex, but Professor Baird assured me that as rapidly as the collection might be increased space would be given to it. Mr. President, and gentlemen, I thank you for giving me this opportunity to present to you the claims of the National Museum. [Applause.]

NOTE—Since the adjournment of the Association the Secretary has received the following letter from Prof. Baird:

UNITED STATES NATIONAL MUSEUM,
UNDER DIRECTION OF
THE SMITHSONIAN INSTITUTION,

WASHINGTON, JUNE 25, 1885.

J. H. Setchel, Esq., Secretary American Railway Master Mechanics' Association:

DEAR SIR—Mr. J. E. Watkins informs me that at the recent Convention of the Society of Master Mechanics' he was afforded by the officers of the Society special facilities for the purpose of explaining the plan of the National Museum for the development of a collection illustrating the history of American railways. I desire through you to extend the thanks of the Museum to the Society for the facilities afforded Mr. Watkins, and for the interest which was manifested in his work. I hope that through the co-operation of the Society Mr. Watkins may be enabled to do very much towards developing this department in which he and all of us are so greatly interested. I have the honor to be,

Yours very respectfully,
SPENCER W. BAIRD,
Secretary Smithsonian Institution, and Director U. S. National Museum.

THE PRESIDENT—The report of the Committee on driving wheel brakes is next in order, but I am sorry to say that there is no report from that Committee. Therefore we will take up the report of the next Committee, that on the testing of boilers by hydraulic pressure.

Mr. Setchel here read the report referred to.

To the American Railway Master Mechanics' Association:

GENTLEMEN—Your Committee appointed to report on the subject of hydraulic tests of locomotive boilers, realizing the fact that it is the general practice to combine other tests with hydraulic, ventured to so far exceed their instructions as to solicit information on other tests in connection therewith, issuing the following circular:

CINCINNATI, Jan., 1885.

To the Members of the Master Mechanics' Association:

Your Committee on Hydraulic Boiler Tests, solicit answers to following questions:

1. Is the frequent testing of boilers by hydraulic pressure desirable? If so, how often should these tests be made? What excess over working pressure should be applied, and why?

2. Do you recommend other tests in connection with hydraulic? If so, what other tests, and why?

3. Do you consider the test of a locomotive boiler at rest by hydraulic pressure, conclusive to its safety under all conditions of service?

4. Please give any information you may have on this subject not called for in the foregoing questions.

Replies to be sent before April 1, 1885, to H. N. Sprague, Pittsburgh, Pa.

H. N. SPRAGUE,
Of H. K. Porter & Co.
W. L. HOFFECKER,
Of P. C. & T. R. R.
D. O. SHAVER,
Of P. R. R.
Committee.

Having received replies from thirteen members from a total of some two hundred and forty, we are curious to know what opinion, if any, the remaining members hold on the subject and trust they may respond generously in convention. Of the thirteen replying to the circular, three are entirely opposed to hydraulic tests, one saying he thinks it an injury to a boiler, and another says he has seen a boiler tested to one hundred and twenty pounds by hydraulic pressure, that leaked at every joint and was perfectly tight under an equal pressure of steam. Of the ten members reporting, who favor hydraulic tests, all give decided preference to hot over cold water as giving proper expansion to the parts, and favor the introduction of hot water in preference to firing the boiler filled with cold water as the want of circulation by this plan is likely to produce unequal expansion, and while some favor frequent tests and others think them only necessary after general repairs to boilers, they all recommend careful inspection to detect pitt ng and grooving and hammer tests to detect defective stays and braces. The excess of test over-working pressure recommended by different members, varies from twenty-five to forty-five pounds, and while they do not consider the test at rest, conclusive as to its perfect safety under all conditions of service, yet, as conclusive as any test under such conditions.

Mr. Lawson of the Lawson Non-Explosive Boiler Company to whom a circular was sent, replies: I think hydraulic tests desirable with pressure sufficient to discover leaks and weak parts which might

escape the eye, and as often as there is reason to think that parts of the boiler may have become weak from corrosion or other causes, I think a pressure not exceeding one fifth of the tensile strength of the boiler, can do no harm to the seams.

Mr. Johann of the W. St. L. & P. says: I am decidedly opposed to the excessive cold hydraulic test as I consider it liable to create a defect where none previously existed, but uses the hot hydraulic pressure applying it with the Rue Boiler Test (with which most of you are doubtless familiar) and connecting to a system of steam pipes running to the pits.

Mr. Barnett of the Grand Trunk favors careful dimensioning of the boiler both under pressure and after pressure is removed, to determine if any alteration of shape occurs or permanent set after pressure is removed.

The Hartford Steam Boiler Inspection and Insurance Company acknowledged the receipt of our circular and promised to give their views, but up to date have not responded.

Your Committee after a somewhat extended experience in testing both new and old boilers, added to what information they have gained from other sources, would respecffully recommend that all boilers intended to carry ordinary pressure in service, should be tested when new to 180 pounds hydraulic pressure, by introducing hot water and after the boiler shall have become warmed so as to produce uniform expansion, the pressure to be applied and a careful examination made to determine if any change of shape is produced in any of the parts that would indicate weakness in design or material, and an examination after pressure is removed of stays and braces, to see if any weakness is developed or undue strain thrown upon individual members, for we are thoroughly of the opinion that a new boiler that will not stand a hot water pressure of 180 pounds without movement of its parts or overstraining, is not absolutely safe to stand the strains of service through its ordinary life.

For all subsequent tests preceded by careful inspection, especially of stay bolts, by hammer test, we would recommend a hydyaulic pressure by hot water of not less than 25 pounds above working pressure. We consider a pressure test, the only perfect one for a boiler, inasmuch, as it reaches every point and exposes every defect possible to reach at rest. Defects that, through inadvertence or

positition, might escape other methods, will not escape this. We also believe hot water will expose a leak more readily than steam, and can be much more economically applied, and is also much more cleanly in its application, we most heartily recommend it as the most proper test available. And now in conclusion, we approach the question of the frequency of tests with some trepidation, but inasmuch as the efficiency of any method depends upon its systematic application, we are constrained to recommend a periodical inspection and test every twelve months for the first two years of the life of a boiler, and thereafter every six months of all boilers in service.

Respectfully,

H. N. SPRAGUE,
W. L. HOFFECKER, } Committee.
D. O. SHAVER,

MR. SPRAGUE—I would suggest that the rules of the Pennsylvania railroad in reference to testing boilers be read in connection with the report, as it is a perfect system of boiler testing.

On motion of Mr. Lauder, seconded by Mr. Johann, the same were read.

PENNSYLVANIA RAILROAD COMPANY.

MOTIVE POWER DEPARTMENT. PENNSYLVANIA RAILROAD DIVISION.

RULES FOR TESTING BOILERS.

BOILERS OF LOCOMOTIVES.

The boilers of new locomotives must be subjected to an hydraulic pressure of twenty-five (25) pounds per square inch above their rated working pressure before going into service.

This test must be made once a year for the first two years, and thereafter every six months.

When boilers are being tested, the foreman of the machine shop having under his charge the repairs of locomotives, must attend personally, remaining outside, while an assistant examines the firebox from the inside.

A record of all tests must be made, giving dates, and anything worthy of mention, which must be signed by the foreman and the person assisting.

The boiler must be heated to near the boiling point of water before the test is commenced.

Special examination of the stay bolts of locomotives in service must be made not less frequently than once every week.

An inspector especially trained for the service must tap each stay-bolt from the fire box side, and judge from the sound, which of them are broken.

When these examinations are made there must be not less than thirty (30) pounds of steam pressure upon the boiler, which will produce sufficient strain upon the stay-bolts to cause the separation of the parts of broken ones. Should the boiler not be fired up, the examination may be made after drawing all the water from the boiler, in which case the vibration of the sheet after striking the bolt will indicate any unsoundness. The latter test is preferable when it can be made without inconvenience.

He must keep an accurate record of the location of each imperfect bolt, and report the same to the master mechanic, who will decide, from the position of the bolts and the construction of the boiler, whether the locomotive must be withdrawn from the service.

No locomotive must be allowed to remain in service when there are one or more stay bolts broken in the top row.

The dates of all tests of boilers and examination of stay bolts must be given by the Road Foreman of engines on their monthly reports to this office.

STATIONARY BOILERS.

Stationary boilers carrying 100 pounds pressure per square inch must be tested in accordance with the instructions given for locomotive boilers, including the examination of stay bolts.

Stationary boilers carrying less than 100 pounds pressure per square inch must be subjected to an hydraulic pressure of fifty per cent. in excess of their rated pressure, once in every six months, and a special examination made of the stay bolts both before and after the pressure has been applied, in the manner prescribed for the examination of the stay bolts of locomotives.

Stationary boilers of odd types, such as those used over heating furnaces, must be tested the same as other stationary boilers, so far as the pressure and dates of test are concerned, and must be examined with reference to the particular construction of each boiler.

It must be understood that the foregoing rules apply to all boilers, whether located at the shops or at outlying points, and that they are in the direct charge of the master mechanic in whose district they may be placed.

The dates of all tests and examinations must be promptly reported to this office, giving also the general condition of the boilers and noting any stay bolts or braces found to be broken.

F. L. SHEPPARD,
Sup't Motive Power.

Approved as standard.

THEO. N. ELY,
Gen'l Sup't Motive Power.

ALTOONA, PA., July 15, 1884.

On motion of Mr. Black, seconded by Mr. Sinclair, the report of the Committee was received.

MR. STEVENS—If any gentleman is here from the Pennsylvania road I would like to have him say whether that order does exist in fact, and if so, how they provide for testing the bolts, and testing the boilers of engines that are located at outlying stations away from headquarters?

MR. SHAVER—Our instructions are to carry out that order, and we do it right to the letter. We provide men to go to outlying points and examine locomotives. We examine and test the stay bolts once a week, and all engines coming into the shop from different points on the road are all tested at the shops.

MR. STEVENS—There should be nothing left undone of course, that would lessen safety, but I think this matter of testing stay bolts once a week is unnecessary, for less than one half of one per cent. of stay bolts were found broken in examinations that I made extending over a period of one year.

MR. WHITNEY—I think it is mentioned in the report something about testing boilers once every six months. Do they purpose removing all the covering from the boiler? If they don't what is the use of the test? and if they do, what is the use of the test?

MR. SHAVER—The general inspection is made when an engine is in the shop for repairs. We merely test the boiler with boiler pressure every six months, and we examine the stay bolts once a week.

MR. BRIGGS—How often is the cylinder part of the boiler tested?

MR. SHAVER—Every time it is examined. When a locomotive is taken to the shop for renewing of the jackets or flues it is usually for that purpose—to examine the boilers.

MR. SPRAGUE—I suppose that the frequency of test would be considered objectionable, but when you come to consider the service that some engines are in, and when they begin to get old if we wish to feel absolutely safe with them, it seems to me they ought to be tested as often as once in six months, and you will notice that the time of testing is the same as that of the Pennsylvania road. A test of any kind, unless it is

periodical, will not be reliable. If you tell a man to test a boiler every six months or so, you don't know when he does it. You must fix a time.

MR. SHAVER—It has never been my fortune to have an explosion on a road that I have been connected with yet. Usually when there is an explosion the first question is: When was this boiler tested? And if you don't have a regular record of them it is pretty hard to swear to something that we are not positive of.

MR. FINLEY—I think if we had more frequent tests of boilers we would have fewer accidents.

MR. BRIGGS—I do not see how you can test a boiler without taking the flues out. I cannot see how it is practical for any road to test a boiler every six months that is hardly able to pay its fixed charges. We all know that the cylinder defects in a boiler start from the inside, and if you are going to make a rule to test a boiler at any time between the beginning and the life of a flue you entail an expense that nine-tenths of the railroads cannot stand.

MR. FINLEY—In testing a boiler the cylinder part between the laps, although we do not notice it, immediately after the test very soon develops its weakness; and we get at it earlier in that way than if we let time elapse to bring it to a development explosion.

MR. SPRAGUE—There are also a great many broken stay bolts detected by this test, and it is very valuable in that respect. Mr. Shaver says that it is a common practice with them to notice the popping of stay bolts during this test, and it enables them to discover those defective stay bolts before they do damage in other ways.

MR. WHITNEY—It is the custom on our road, and I suppose it is on all well conducted roads, to examine the boilers thoroughly every time they come into the shop for general repairs. The tubes are taken out and the test applied, and a record kept of the time of the test, and the pressure applied for it. Then occasionally when the engine is in service, the dome covers are taken off so that we can examine the inside over the fire box. Our domes are all over the fire-boxes. In twenty-five years experience we have never found it necessary to test the boiler once in six months. There is no use of testing a boiler unless you can get into the inside of it. We also measure the boiler before and after the test is made to see if there is any change in the position of the boiler.

On motion of Mr. Briggs, seconded by Mr. Whitney, the discussion of this report was closed.

THE PRESIDENT—I will suggest that while the blue prints and drawings which accompany the next report of the Committee on Smoke Stacks and Spark Arresters are being put in position that we take up new business:

MR. JOHANN—I offer the following resolution:—

"Resolved, that hereafter all papers prepared by persons not members of the Association to be read at the regular meeting of this body shall be handed in to the Supervisory Committee at least 30 days before the time at which they are designed to be read, and no such papers shall be read unless with the approval of said committee."

MR. BRIGGS—I move the adoption of that resolution.

MR. SPRAGUE—I second the motion.

THE PRESIDENT—Is it clearly understood that the acceptance by the Supervisory Committee carries with it the promise to print? I think the members ought to understand that.

MR. JOHANN—It is the intention of that resolution that any paper that shall be presented to the Supervisory Committee, that Committee is to determine whether it shall be read to the Association, and shall be published in our proceedings. In other words the Supervisory Committee have the veto power whether the paper shall be read or not.

MR. SHAVER—Are we to infer from that, that we must be to the expense of printing the papers?

THE PRESIDENT—That is the substance of the motion. I ought to explain to the members that the practice of the Association has been—although there is no rule on the subject—that all outside papers, papers not asked for definitely at a previous Convention, ought to be sent in, and are subject to the approval of the Supervisory Committee before being read. I think that is the proper practice, as the officers of the Association should know something of the matter that is to be brought before them. But the reading of the paper does not carry with it the printing of the paper also in our proceedings.

MR. SHAVER—While I am in favor of getting all the information we can, there is no use of making provision to spend money before we get it, and it seems to me that if we can throw in anything that may be offered, somebody has got to pay for it.

MR. JOHANN—I see the force of that, and I withdraw the printing part of the resolution.

MR. SETCHEL—If the Association will listen to the resolution they will find that it is all right, the word printing does not appear.

(Mr. Setchel then read the resolution again.)

MR. SPRAGUE—Suppose the Supervisory Committee allowed the paper to be read, then they would place it before not over twenty-five per cent. of the members, and they refuse to print it and place it before the other seventy-five per cent. The debate after a paper is read, shows whether we approve of it or not, and I think the question of printing a paper is a small matter. If it is read you only put it before those of the members who are present, while the majority, who are not here, can

form no judgment about it unless the paper is printed in our proceedings.

MR. SETCHEL—Allow me to say that it is not alone the expense of printing. The most of these technical papers involve a large number of drawings. There is an expense attached to that which it is doubtful that we can afford.

MR. STEVENS—It seems to me that it is a handicap to have these papers submitted to the Supervisory Committee, and I am going to enter a protest against that Committee having the right to say whether a paper shall be read before this Association or not. What we want is knowledge. We can take care of those matters as they come along, and the Convention can decide whether they shall be published or not. You are apt to place the majority in the hands of the minority, by giving the Supervisory Committee absolute power over these papers, and that is contrary to this American form of government. The minority must be heard. That has been demonstrated time and time again. It is all right to have a Committee examine them and say what in their judgment should be done, but as for their heading them off and stopping them, it is a handicap, and I protest against it.

MR. HATSWELL—I move that the resolution be laid on the table.

MR. McCRUM—I second the motion.

The question was put, and the result being in doubt, a division of the vote was called for, whereupon the resolution of Mr. Johann was tabled by a vote of 34 to 16.

MR. LOCKWOOD—I now call up my resolution, which is in the hands of the Secretary.

MR. SETCHEL—The resolution is as follows:

Resolved, that a committee of five be appointed by the chair to consider and confer with a similar committee of the Franklin Institute looking to the weighing of the hammer blow at the coming novelty exibition of that Institute. Should such a test for any cause fail to be made, the committee shall refer the data obtained to the Committee on Subjects to be considered at the next annual meeting.

MR. LOCKWOOD—The novelty exposition is to be confined exclusively to novelty. It would be an opportunity to present this subject there without expense to this Association, and a committee to determine upon the mode of weighing that blow, and the absolute test will be made not with toys but with engines and mechanical appliances. That is the test that is supposed to be made there. One test that has been approved, not weighing simply by location; I do not believe it can be weighed when you add the weighing of translation. The authorities are all on the side that the blow is struck. I have yet to find a locomotive engineer that doubts it; a majority of master mechanics believe it,

and the only men I have heard who said it did not exist were skilled experts and general managers of railroads. If it does exist it is a subject worthy of the consideration of this Association, and if it does not exist that question will be determined and settled.

MR. DEVINE—I second that resolution.

Carried.

MR. JOHANN—I have reports here on the application of Robert Grimshaw and John A. Coleman, to become Associate Members, signed by the Committee, recommending the admission of the candidates.

On motion of Mr. Sprague, seconded by Mr. Blackwell, the reports were received.

A vote was then taken and Mr. Grimshaw was unanimously elected.

A vote was then taken on the election of Mr. Coleman, and he was elected by a vote of 39 to 1.

MR. SETCHEL—Within the last year I have received an application, very modestly made from each of the following members, saying that they would feel gratified if they were made honorary members of this Association: James Sedgely, J. W. Philbrick, and H. A. Towne. The mention of these names will entitle these members, I think, to what they ask for, as they are old members and have always been efficient ones.

MR. WHITNEY—I move that they all be placed on the honorary list.

MR. BRIGGS—I second the motion.

Carried.

THE PRESIDENT—The Secretary will now read the report of the Committee on Smoke Stacks and Spark Arresters.

REPORT OF COMMITTEE ON SMOKE STACKS AND SPARK ARRESTERS.

To the American Railway Master Mechanics' Association:

GENTLEMEN:—Your Committee appointed at the last Annual Convention to report on the subject of Smoke Stacks and Spark Arresters issued the following circular:

To Members of the American Railway Master Mechanics' Association:

Your Committee on Smoke Stacks and Spark Arresters respectfully requests replies to the following questions:

1st. What form of smoke stacks do you use in connection with the ordinary smoke arch? Please give dimensions and results obtained.

2nd. Are you using any form of spark arresters or extension front ends? If so, state how constructed and results obtained.

3rd. What has been your experience with the fire-brick arch or other device in the fire-box, in connection with the extension front as compared with the ordinary smoke arch?

The Committee desires to make as full and complete a report as possible, and earnestly requests the members to give us, as early as convenient, any information bearing on this subject, not confining themselves entirely to the questions propounded above, but giving any information obtainable in addition to that requested.

It is also desirable that drawings or sketches giving dimensions of the various devices be furnished with your report.

Please send replies to W. F. Turreff, G. M. M., C. C. C. & I. Railway, Cleveland, O.

W. F. TURREFF,
GEO. B. ROSS,
W. T. SMITH,
Committee.

These circulars were sent to each member of the Association, to which we received 27 replies.

Your Committee were disappointed in the majority of the answers received, in so far that the members have given their experience only in a general way; this arises no doubt from the fact that no comparative tests have been made, which is greatly to be regretted, as such tests would have been of the greatest value towards the solution of that vexed question, "Which is the best and most economical smoke stack and spark-arrester?"

While we have not met with that general response to our queries that we had hoped to, still we are glad to state that a few of our members have furnished the Committee some facts that can be called decisive. The past year has shown little or no improvement in smoke stacks or spark-arresters, and when new devices are sifted out it is generally found to be some modification of some older form. In some of the blue prints furnished the Committee an improvement in details only can be noticed. The majority of the drawings sent represent the prevailing practice with which the members are familiar, so that there is no necessity for a discussion of their respective merits or demerits.

Mr. D. Barnett, of the Grand Trunk Railway of Canada, has sent your Committee a blue print of extended front, of which the most

notable feature is an adjustable diaphragm plate, this is effected by a shaft passing through smoke box, from side to side. This shaft has three levers, two of which are connected with the diaphragm plate and the third lever is outside of the smoke box, and is connected with a rod leading to the cab, where the diaphragm can be adjusted to any degree thought proper. Mr. Barnett says in answer to the questions propounded: "We are using extended smoke boxes on our engines, and although the result is most satisfactory, so far as the comfort of the passengers is concerned in freedom from cinders, I cannot say that the amount of steam produced is satisfactory when engine is loaded to its designed capacity of 12 or 14 coaches.

"The results both to comfort and economy are satisfactory with say 8 coaches." Mr. Barnett further says, "We have always used fire-brick arches in connection with extension fronts, and did so on passenger locomotives before experimenting with extended front ends, so as to lessen the discomfort to passengers. A long and thorough test with fire-brick arches has shown that their expense in first cost, in repeated renewals, and in occasional injury to side sheets of furnace more than counterbalances any reduction in the fuel bill resulting from their use."

Mr. Jacob Johann, of the Wabash, St. Louis & Pacific Railway, says: "He is trying a device called the Hunter Spark Arrester;* this device is, as its name implies, a spark-arrester, and with our light trains, where the engines are not forced to their utmost capacity, it works well, the engine steaming well and the arrester performing its duty thoroughly. On heavy trains, however, where the engines are required to work to their full capacity to make running time the device is apt to become clogged up with sparks, the arch and netting filling up and seriously interfering with the steaming of the engine. Owing to this defect the engine having this device was unable to make up lost time, and in some instances failed to make running time." Mr. Johann states that at last accounts the inventor was trying to overcome this cause for complaint.

Mr. Cushing, of the Northern Pacific Railway, has sent the Committee a drawing of a smoke stack, such as used in the early days of coal burning. He says, "I have used this stack now for

* NOTE—The details of this stack were published in the 16th Annual Report.—SEC.

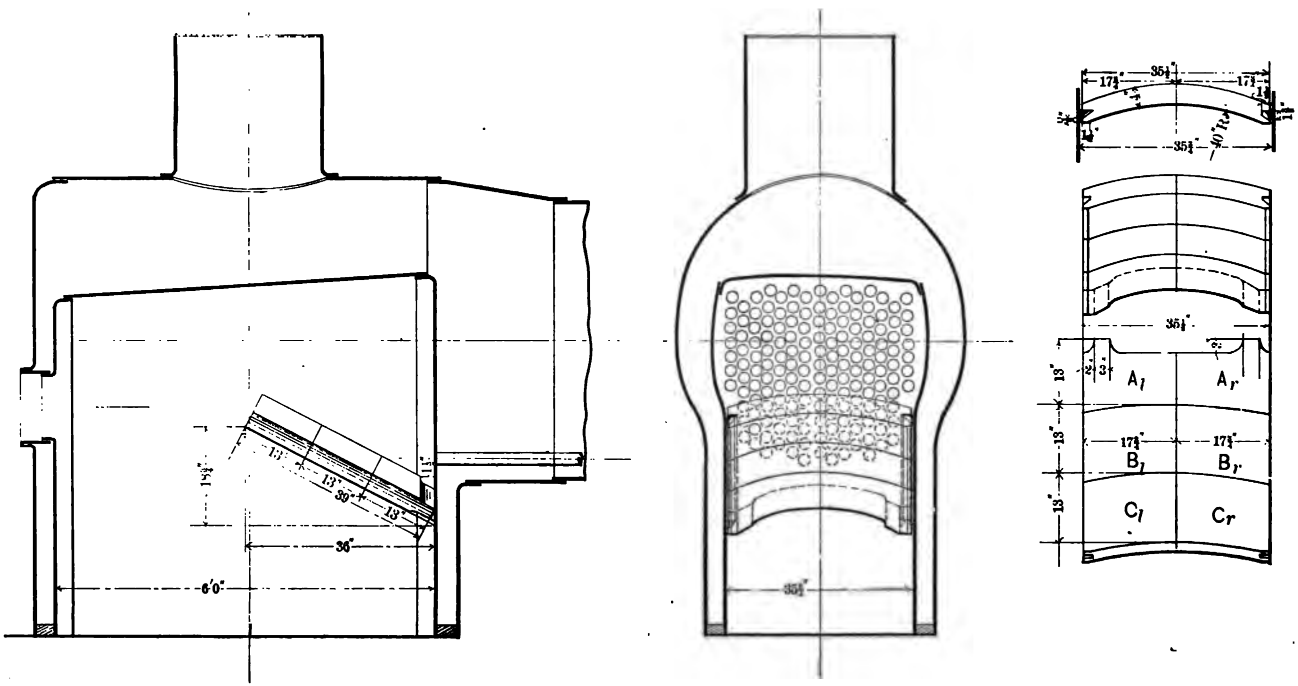


Plate 51. Standard Brick Arch Pennsylvania Company.

s as a standard, occasionally experimenting with others, ıave from time to time been brought to notice, but I have ›ack on the old device as being, in my opinion, the best, all considered. The stack is as perfect a spark-arrester as any in my practice."

. Joseph Wood, of the Pennsylvania Company, has furnished Committee with a number of drawings that indicate the prac- ›f this company in regard to smoke stacks and spark-arresters te 51). Mr. Wood says in answer to the circular: "The ex- ed front as shown is considered to give better results as a k-arrester than either the Diamond or Smith Stack; it improves steaming qualities of engines to some extent, but does not, as far this company's experience goes, show any economy in the con- ption of fuel over the other forms of front ends in use, its merits that it is, in our opinion, an excellent spark-arrester, and that it so contributes to the comfort of traveling by rail.

"A number of devices have been tried in fire-boxes to reduce the consumption of fuel, but none seemed to be of any value except the arch. This device with and without the extended front has, where it can be used, shown a marked econony in the use of fuel.

"From numerous experiments made here and on the Pennsylvania Rail Road, I would say that with the arch a reduction of 12 to 15 per cent. in the consumption of fuel can be had. On one division of this company's lines the coal used contains such impurities that large deposits are formed on the flue sheet during each trip; it is necessary to remove these deposites, and to do so the arch must be removed. The cost of removing and replacing arch daily is greater than the saving in fuel.

"On another division, where water is very bad, with the arch there was found a tendency of crown sheet to burn directly over back end of arch where the heat was greatest. With fairly good water and ordinarily pure coal very good results are obtained from the arch."

Mr. J. N. Lauder, of the Old Colony Rail Road, has sent your Committee blue prints, showing the arrangement of extended fronts, and the method of getting rid of the sparks (see Plate 52). Mr. Lauder says: "It makes a perfect spark-arrester and works well in every way, and that he has used this extension front with and

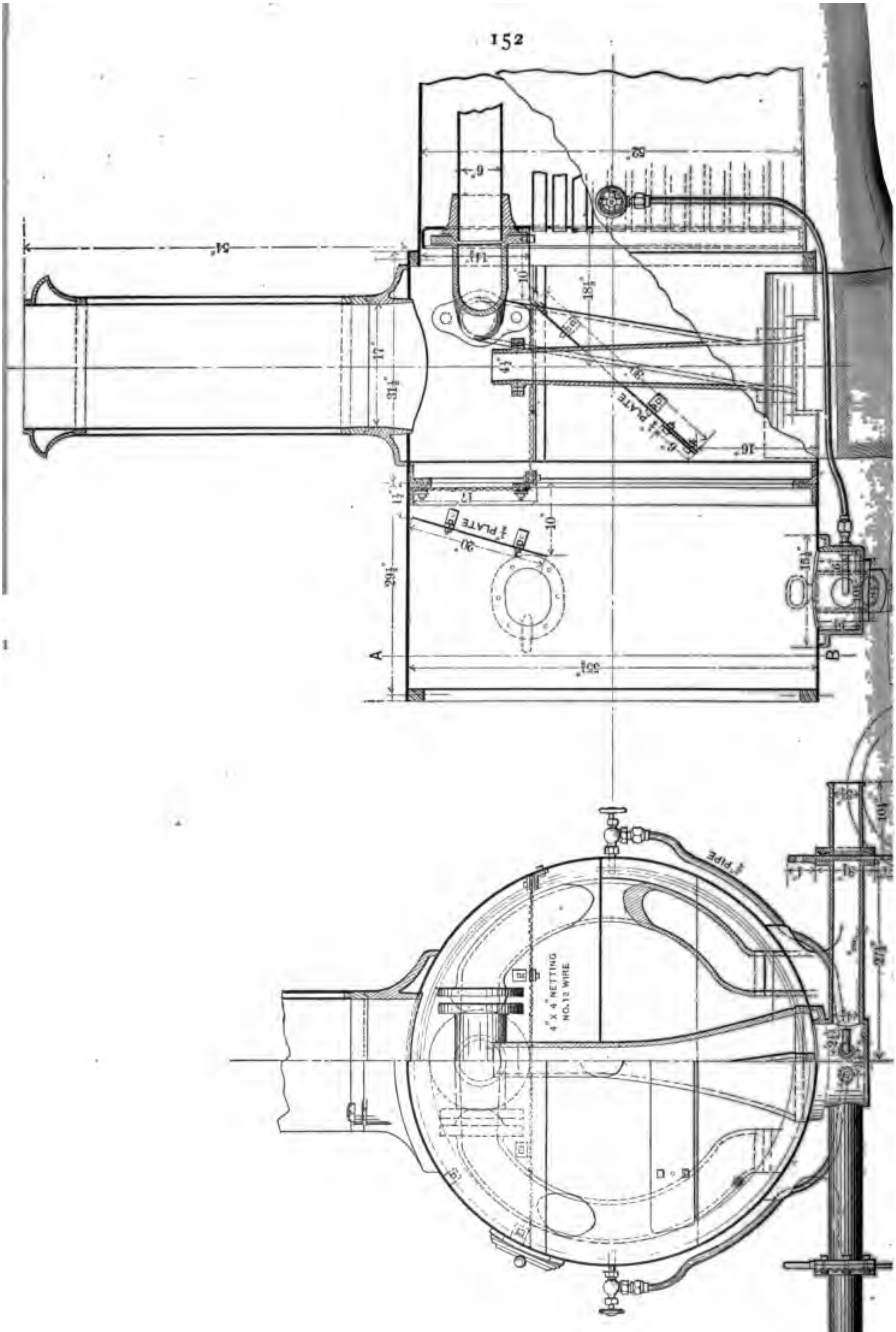
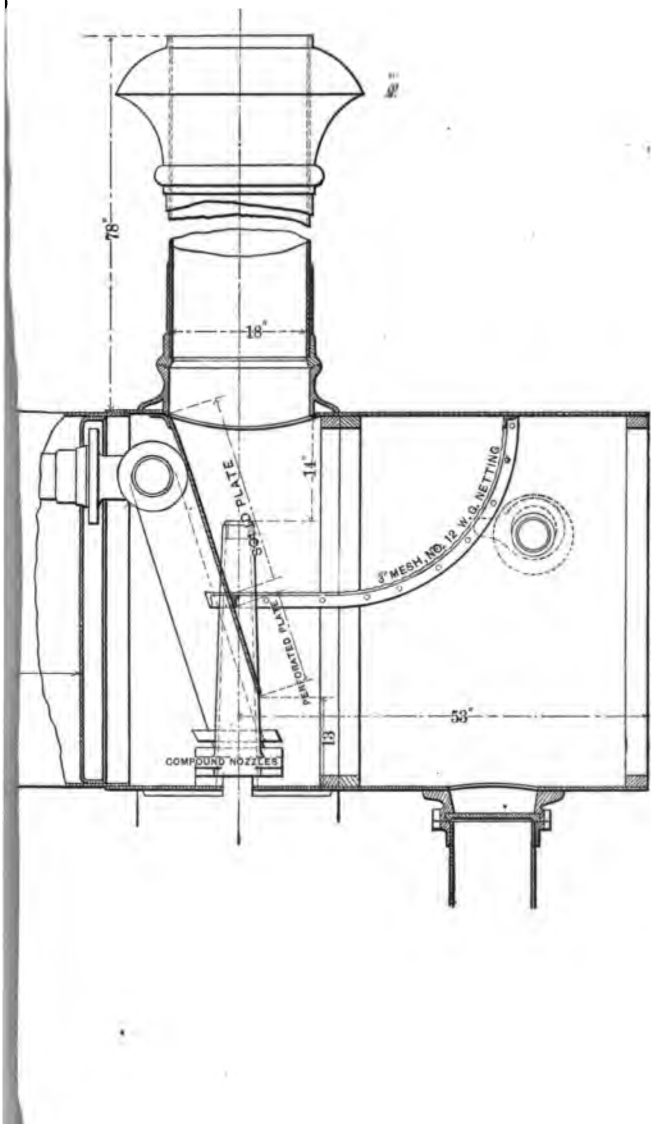
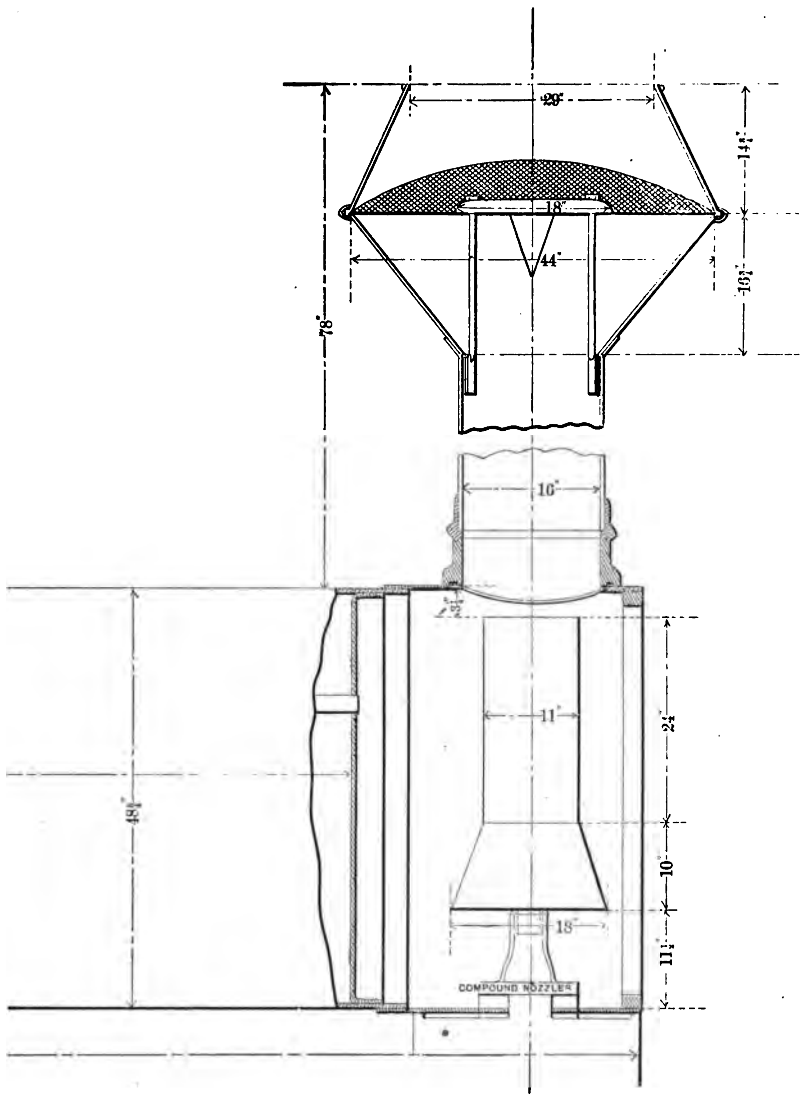


Plate 52. Old Colony Extended Front.


78"
18"
14"
SOLID PLATE
3" MESH, NO. 12 W.G. NETTING
PERFORATED PLATE
53"
13
COMPOUND NOZZLES



C. & I. R. R.

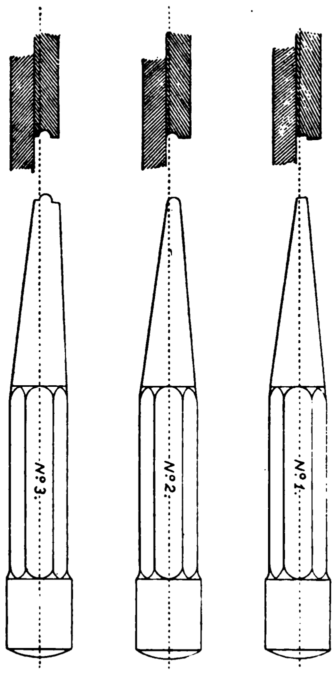


Plate 55.

PAT. CALKING TOOL.

without fire-brick arches, and can see very little to be gained by the use of the arch."

Your Committee has noticed on the blue print of the extended front furnished by Mr. Lauder, a new arrangement for cleaning the extended front of the accumulated sparks. This device consists of a 4¼" pipe, 76" long, having an enlarged receptacle in the center of its length, this receptacle has a flange by which it is fastened to the bottom of the extended front, so that the pipe will be at right angles to the center line of boiler and between the smoke arch and forward section of frames. In the receptacle there are two steam jets, which are connected to the boiler below the water line with globe valves; the spark discharging pipes have two sliding gates, one at each end of the pipe, by opening these sliding gates and turning the water on the sparks they are made to pass at right angles to the center line of engine into a building provided for their reception, situated on either side of the track.

Mr. Lauder says in regard to this method of sparking the extension fronts: "We blow the sparks out at the sides because we think it is cleaner than the other method in use. If the sparks are blown out under the engine with a steam jet, they are thrown over the machinery of engine, whereas, if blown out from the sides they can be thrown into a building provided for that purpose."

A series of tests were made on the C. C. C. & I. Railway, to determine the relative efficiency of Engine No. 152, under four conditions, viz.:—

1st. Engine equipped with fire-brick arch, extended front, high nozzle, and straight stack.

2d. Extended front, high nozzle, and straight stack.

3d. Diamond stack, cone and netting, ordinary smoke arch, short compound nozzle, and brick arch in fire-box.

4th. Diamond stack, cone and netting, ordinary smoke arch, and short compound nozzle.

(See tabulated statement appended.)

Engine No. 152 has 17"x 22" cylinders, and 5½ feet driving wheels, 17.65 square feet of grate surface, and 757.51 square feet of heating surface.

In conducting these tests every known precaution was taken to prevent any error in the data from which these condensed results

were obtained. The coal used was measured in buckets for convenience and also on account of the coal being exposed to the weather.

The correctness of the coal buckets were tested by weighing a number of buckets filled with dry coal, in the manner as practiced by the men engaged in that work, and the error was found to be less than 0.01 of one per cent. The height of water in boiler at the beginning and end of tests were alike. The water in tank was measured by a float, carrying a graduated rod, and corrections were made for unlevel track at water stations. By weighing the tender with and without water it was found that each inch in height gave an additional 458.6 pounds of water. The temperature of the feed water was taken at frequent intervals by a Farenheit thermometer. Steam was occasionally wasted at the safety valve by over pressure, but this was avoided as much as possible. Water was wasted every time the injector was started and our total amounts include this wastage. A careful record was kept of the arrival and departure of the train at each station and at terminal stations so that the actual running time can be relied on.

Taking the evaporation of water from, and at 212 degrees per pound of fuel as a basis of comparison, and representing the performance of the engine in trial No. 2 by 100, their respective performances will be as follows :—

	1	2	3	4
Relative efficiency in the evaporation of water from and at 212 degrees per pound of fuel,	96	100	97	86
In car miles (Pass.) per pound of fuel, - -	97	100	97	97

Tests Nos. 1, 2 and 3 can be fairly compared with each other, as the loaded car mileage are approximate quantities, but unfortunately in the fourth test the loaded car mileage was greatly increased over the mileage in the other trials, and the running time made was somewhat shorter, this has resulted in the greater consumption of coal as compared with the three first tests, so that it would not be fair to compare the last without taking this fact into consideration.

The first three tests will show that there is very little choice between the performance of the engines fitted up in the manner described, so far as economy is concerned, yet taking into consideration the comfort of the traveling public, we think the extended fronts and straight stacks with high nozzles are on that account

some benefit to the road using them, and that with the extended front there is less liability of setting fire to adjacent property along the line of road as compared with the diamond stack and cone with netting. On the C. C. C. & I. Railway, a number of tests were made, a few months previous to the one referred to herein, with fire-brick arches in conjunction with the extended front, and the results were anything but satisfactory, the small saving in fuel in some instances being much more than offset by the first cost and maintainance.

On some roads having pure coal the results may be different. The coal used on the road referred to is not of the best quality, and they found a great deal of trouble in keeping incrustation from forming on the flue sheet, so that before the arch is burnt out it has to be removed to get at the deposits.

As a smoke consumer and spark-arrester the brick arch was found to have some merits, but nothing that would begin to justify a railway company in applying and maintaining the device for that purpose alone.

From the reports furnished we would derive the following conclusions, viz.:—

1st. Where a railway company have the advantages of comparatively pure water and coal they would be justified in the use of the brick arch, on account of its economy in fuel, and not otherwise.

2d. An extension front end when properly constructed, makes a very satisfactory spark-arrester, and as a consequence is less injurious to the paint on cars and adds greatly to the comfort of passengers, and are to be recommended on that account. It also has some merits as an economizer of fuel, but not to any great extent.

3d. With comparatively pure water and coal the extension front end and brick arch can be used in conjunction to advantage, both for cleanliness and economy in fuel.

4th. The Hunter Spark Arrester seems to have some merits as a spark-arrester where a locomotive pulls light trains, but not in cases where heavy trains are hauled, and would seem to require further practical tests before a definite report could be made.

No other devices seem to have any merits as a spark-arrester so far as reported. Respectfully submitted,

W. F. TURREFF,
GEO. B. ROSS, } Committee.
W. T. SMITH,

TEST OF ENGINE No. 152, ENGINE AND BOILER PERFORMANCE.

CLEVELAND, COLUMBUS, CINCINNATI & INDIANAPOLIS RAILWAY CO.

Cleveland, O., May 15th, 1885.

NOTE—On account of change in Time Card, the Car Mileage and Speed of Train were both increased in 4th test.	I Fire Brick Arch, Extended Front, High Compound Nozzles and Straight Stack.	II Extended Front, High Compound Nozzles and Straight Stack.	III Fire Brick Arch, Ordinary Smoke Arch, Low Compound Nozzles, Diamond Stack, Cone and Netting.	IV Ordinary Smoke Arch, Low Compound Nozzles, Diamond Stack, Cone and Netting.
Coal burned, in lbs.	24532	23664	25000	28400
Water evavorated, in lbs.	144844	144800	148068	148528
Pounds of water evaporated per lb. of coal	5.90	6.12	5.92	5.22
Equivalent evaporation, from and at 212° Fah. in lbs. of water per lb. of coal	7.07	7.34	7.10	6.27
Pounds of coal consumed per car mile	7.78	7.60	7.87	7.71
Pounds of water evaporated per car mile	45.95	46.52	46.73	40.36
Cars hauled one mile per ton of coal	256.97	263.01	253.44	259.15
Coal burned per square foot of grate per hour	75.80	76.37	84.66	96.46
Water evaporated per sq. ft. of grate per hour	447.65	450.54	501.44	504.50
Running time, in minutes	1100	1092	1004	1001
Time for stops, in minutes	200	208	176	214
Total time on tests, in minutes	1300	1300	1180	1215
Temperature of feed water, in degrees, Fah.	63°	63°	62°	64°
Average boiler pressure, in lbs., per sq. in.	126	128	127	120
Passenger car mileage	3152	3112	3168	3680
Engine mileage	552	552	552	552
Average number of cars per train	5.71	5.63	5.73	6.66

W. F. TURREFF,

General Master Mechanic.

On motion of Mr. Johann, seconded by Mr. Black, the report was received.

MR. SHAVER—I would ask that Mr. Lockwood be granted the privilege to make a few remarks in regard to Smoke Stacks.

THE PRESIDENT—That is in order, as he is a member.

MR. LOCKWOOD—Our experience is that at the very highest speed, where we had a spark-arrester, it choked the engine. While it worked very well at 45 miles an hour, when we got up to 60 or 65 the engine was all choked up. My further remarks have a direct relation to an engine that does not require a spark-arrester. We exhaust in this engine, out of the smoke stack, and through two 6 inch nozzles. We could not make steam enough to run 65 miles an hour with 3 inch exhaust nozzles, burning soft coal, and we reduced them to 2¾ inches, showing the variation required to make steam enough between those two speeds. Recently we have been burning crude petroleum. The last test was on the main line of the Reading Railroad. The speed test showed 55 miles an hour; the pulling test showed the engine pulling 54 cars, 5 of them only being empty. Weight of engine and train 600 tons. That stalled the engine. With a starter, she took that train, and distributed over the line with a curvature of 12 to 15 degrees, and a grade of 4 feet to the mile, blowing off steam at all times, with 130 to 138 lbs. pressure. She had 5 burners in her; as to the economy of that, the engine had steam up, and remained without any fire under her for twenty-four hours. The cost then was 35 cents to get up 130 lbs. of steam. The estimated cost of burning crude petroleum, so far as this test is concerned, is, that a gallon of crude petroleum will make a train mile of service. That gallon costs 3½ cents. It is very simple in operation. This is the best data we have through our own tests. Other calculations say that 100 lbs. of crude petroleum is equal to 175 lbs. of the best bituminous coal. I have here a statement given to me, as to what they claim: The distinctive features of burning crude petroleum are, by a superheating system in the fire-box, aud mixing it with crude petroleum, converting that into a gas, and burning the gas so that there is no carbon deposited at all, after the engine is once started. Should there be any surplus material in the mixture of the tube, they burn this surplus on an iron plate, and supply a sheet iron pan to catch it, and to aid combustion.

MR. JOHANN—I understand that it will keep us some time yet to get through with our business. I would therefore suggest that we take a recess for one hour, and then try and get all the members present so as to finish up all business.

On motion of Mr. Swanston, seconded by Mr. Blackwell, a recess of one hour was here taken.

Recess.

The Convention reassembled at 3 P. M.

On motion of Mr. Swanston, seconded by Mr. Johann, the names of S. M. Cummings and Wilson Eddy were added to the list of honorary members.

MR. MEEHAN—I have had such universal success with the brick arch that I cannot let the report of the Committee on that point pass. We are using the extension brick arch. We tried the extension first without a brick arch and did not get very good results, execpt in the saving of sparks. We added the brick arch, and I can safely say we got a saving of thirty per cent. We have a much cleaner train. We get away with about seventy per cent. of the smoke. If our engines are used on a heavy train and throws sparks we put another brick on. If they are running on light service we take off a brick. We use the brick extended across the water pipe, and when the brick lays there a short time it becomes solid and fastens itself on to the pipe. We open the space between the brick and the side sheet one and a half to two inches. I cannot understand how it is injurious to the side sheet. We never found any bad effects from it on these sheets, nor to the throat sheets, nor to the crown sheets. We use five different kinds of coal, and we meet with the same success with each. The only question of importance about the extension is to get it tight. If the work is well done and the extension is tight there will never be any trouble. In a few cases when we first commenced with the extension we had some trouble with the extension heating and getting hot and burning out. If we were to throw away the question of economy in the fuel, the economy that we found in the wear and tear of the old fashioned stack and cleaning the flues would make it pay us. We have consolidation engines that have been in service for two years, and on which the front end has not been open. In a short time we got over the difficulty about the extension burning out by paying close attention to its construction. I think Mr. Smith, of the Kentucky Central, has put on the extension in the last few months, and he tells me he is getting just as good results from it as I am. In consequence of considerable variation of opinion about the matter, we had a construction engine that was equipped with the Diamond stack. After the use of the extension and brick arch for two or three years I thought I would put her in service in competition with another engine in about the same condition. Engine 22 was equipped with the Diamond stack. Engine 17 had the extension and brick arch. We put them in service on an accommodation train, and we got the same results that we did when we commenced. Our engines will maintain 145 pounds pressure against a number 9 Monitor injector, and I believe the number 9 Monitor injector that we use has a little more capacity than the ordinary No. 9. Our engines are very large and pull very heavy trains. The injector will deliver about 3000 gallons an hour.

MR. TURREFF—The Committee state that economical results could be obtained with good fuel. We did not want to have it stated that there was no economy in the use of the brick arch.

MR. MEEHAN—I would state that the fuel we are using is not No. 1 fuel. If there is any gentleman here from Alabama or Tennessee they know the quality of coal we are using there. Even with the slack coal that we are burning in switch engines—which we buy for 15 cents a ton, while a fair article of coal costs $1.80—we get the very best of results with the brick arch and extension.

MR. BLACKWELL—Before I left the Norfolk and Western road we were getting excellent results from burning slack coal that cost fifty cents a ton, and we burned it satisfactorily with the brick arch and extension front and had no trouble with our heaviest freight trains, drawn by 20 x 24 cylinder engines. The economy in using slack coal, owing to the difference in the price, we found amounted to something in the neighborhood of $80 per engine, per year.

MR. WOODCOCK—I think in a former statement a year or two ago I made reference to the smoke box and stated that we estimated a saving of 20 per cent. over the old style. We now have some thirty-five extension boxes all of which work very satisfactorily, and I have no reason to make any correction in the former statement. I believe we are saving some fuel, but independent of that I think the advantage we have gained pays in preventing fire. We consider it the most satisfactory spark-arrester thet we have ever used—especially with anthracite coal.

On motion of Mr. Briggs, seconded by Mr. Sprague, the discussion of this subject was closed.

MR. SETCHEL—The Committee on Subjects for the next annual meeting report as follows:

1. Boilers; Improvement in construction.
2. Standard Driving Wheel Centre, and Standard section of tire.
3. Driving wheel brakes; to what extent is their use advisable, and the best mode of application.
4. Balance slide valves.
5. Best material and form of construction for locomotive guides and cross heads.
6. Best plan of removing, cleaning and resetting flues.
7. Shop tools and Machinery.

On motion of Mr. Johann, seconded by Mr. Whitney, the report was received.

MR. SETCHEL—Mr. Stevens has handed in a question; What value are self dumping ash pans?

On motion of Mr. Johann, seconded by Mr. Briggs, the same was laid over until the next annual convention.

MR. SETCHEL—The Committee on next place of meeting report the following places from which to decide:

Saratoga, Boston, Minneapolis.

On motion of Mr. Johann, seconded by Mr. Hatswell, the report was received.

MR. HATSWELL—I would move that the name of Niagara Falls be added to that list.

MR. SHAVER—I second that motion.

Lost.

On motion of Mr. Whitney, seconded by Mr. Hatswell, the name of Alexandria Bay was added to the list.

On motion of Mr. Setchel, seconded by Mr. Johann, the Convention proceeded to ballot for a place of meeting.

On motion of Mr. Meehan, seconded by Mr. Lauder, the name of Chattanooga, Tennessee, was added to the list.

MR. LAUDER—Before a vote is taken I want to say that I hope this Convention will meet next year at Boston. Personally I would rather go to Minneapolis than any other place, because I would like to take a western trip; but if you come to Boston we will try and take good care of you, and I think it is as interesting a place as you can come to.

MR. HATSWELL—I move that it is the unanimous sense of this Convention that we meet next year at Boston, Mass.

MR. LAUDER—I will second that motion, although I believe that the thing should be put to vote. Let us ballot.

MR. HATSWELL—Very well. I withdraw my motion.

Upon a ballot being taken the followiug was the result:

Boston, 35; Chattanooga, 11; Alexandria Bay, 8; Saratoga, 2.

THE PRESIDENT—Boston having a vote larger than all the other places together, I think we must declare that as the choice of the Convention for our next place of meeting.

On motion of Mr. Eastman, seconded by Mr. Johann, Boston was declared the unanimous choice of the Convention for the next place of meeting.

On motion of Mr. Johann, seconded by Mr. Sprague, the compensation of the Secretary for the past year was fixed at $800.

MR. LAUDER—I would introduce the following resolution:

Resolved, that the American Railway Master Mechanics' Association has heard with pleasure of the establishment by the directory of the National Museum of Steam Transportation—railway and steamship—for the purpose of collecting and procuring materials which will illustrate the railway history and development of this country. The Association hereby heartily endorses the action referred to, and recommends that its members, so far as they can assist Mr. Watkins, the curator in

charge, in making such a collection as will fulfill the purposes for which the department has been established.

MR. SETCHEL—I second the resolution.

Adopted.

THE PRESIDENT—As under Mr. Lockwood's motion the chair should appoint five members to attend the test at the Novelty exhibition, in Philadelphia, I would appoint on that committee from our associate membership, Mr. William Woodcock, Mr. F. W. Dean and Mr. Angus Sinclair, and, with them, Mr. C. Blackwell,* and Mr. T. L. Chapman,

The Convention then proceeded to ballot for officers, with the following result:

For President, J. Davis Barnett, 45; J. H. Setchel, 11; H. S. Bryan, 1.

MR. BARNETT—I am very much obliged to this Association. I came here a perfect stranger, and have received nothing but kindness from the Association. It is a departure from your practice in the past, which has been to elect a much older man and older member of the Association than myself. In occupying the chair at this Convention I felt that I did so under very awkward circumstances. I thank you for the way in which you have assisted me throughout this meeting, and I promise you that I will do all that is in my power to forward the interests of this Association during the ensuing year, and I hope you will not be disappointed in your choice. [Applause.]

On motion of Mr. Setchel, seconded by Mr. Jonann, the election of Mr. Barnett was made unanimous.

A vote was then taken for first Vice-president, with the following result.

Mr. William Woodcock, received 46 votes, being the total number cast, Mr. Devine having withdrawn his name before the ballot was taken.

MR. WOODCOCK—Mr. President and Gentlemen of the Convention. I thank you most heartily for this renewed token of your confidence. I trust that I shall ever merit it and do nothing but what shall accord with your wishes and be for the success of this Association.

A vote was then taken for second Vice-president, with the following result:

Mr. Johann, 30; Mr. Briggs, 10; Mr. Colby, 6; Mr. Devine, 2; Mr. Griggs, 1.

On motion of Mr. Sprague, seconded by Mr. Briggs, the election of Mr. Johann was made unanimous by a rising vote.

MR. JOHANN—Mr. President and Gentlemen of the Convention. I thank you for the honor conferred upon me. I can only say that I have

*NOTE.—Mr. Blackwell declined to serve and Coleman Sellers was appointed in his place.—SECRETARY.

always considered it an honor to be a member of this Association, and so long as you have bestowed your confidence upon me and elected me to an office, I can only say that I shall endeavor to do my duty in the future as I have tried to do it in the past.

A ballot was then taken for Secretary, which resulted in Mr. Setchel receiving 50 votes, the whole number cast.

MR. SETCHEL—Mr. President and Gentlemen. This honor has been given me so often that I cannot be expected to have much to say about it. This is the sixteenth time that you have elected me Secretary. I will try to do as well in the next year as I have done in the previous years, and, if I succeed in doing that, I hope at least that you will try to be satisfied. [Applause.]

A ballot was then taken for Treasurer, which resulted in 51 votes being cast for Mr. George Richards.

MR. LAUDER—I wish to say that the reason why Mr. Richards is not here is that he is in Europe on business.

A ballot was then taken for member of the Committee on Subjects, which resulted in 25 votes being cast for Mr. Blackwell, and 2 votes for Mr. Clark. Mr. Blackwell was then declared elected.

MR. BLACKWELL—Gentlemen. I thank you for the honor conferred upon me.

On motion of Mr. Johann, seconded by Mr. Black, the following resolution was carried unanimously:

Resolved, that we unanimously thank our officers for the duties they have performed during the last year.

MR. SETCHEL—The report of the committee on resolutions is as follows:

Resolved, that the thanks of the Association are due, and are hereby tendered to the Rev. Byron Sunderland, D. D., to the Hon. James B. Edmonds, to the Committee of Arrangements, to the Committee on Entertainment, to the proprietor of Willard's Hotel, to the ladies present, and to the members of the press, for their various attention which has contributed much to the success of the meeting and the enjoyment of the members.

On motion of Mr. Sprague, seconded by Mr. Johann, the report was accepted and adopted.

MR. SETCHEL—Here is a card which amounts to an invitation, which I am requested to read.

"The members of the Master Mechanics' Association and their friends are cordially invited to an excursion down the Potomac River, Friday, June 19, to Mt. Vernon; conveyances will leave the hotel at 9.30 sharp, returning to Washington by 3.30. Lunch will be provided at Mt. Vernon. By order of the Committee of Arrangements."

Mr. Lauder—There was an inquiry made a while ago as to the character of relics or drawings or machinery that any of us that chose to do so might give to the National Museum. I think that circulars will be issued by the Museum and sent to members giving full information on that subject. I am not authorized to make that statement, but I think that will be done.

On motion of Mr. Johann, seconded by Mr. Lauder, the Convention adjourned to meet on the third Tuesday of June, 1886, at Boston, Mass.

COMMITTEES AND SUBJECTS FOR DISCUSSION AT THE NINETEENTH ANNUAL MEETING.

Improvement in Boiler Construction.

G. W. STEVENS,
WILLIAM FULLER,
T. J. HATSWELL,
Committee.

Standard Driving Wheel Centers, and Standard Sections of Tire.

J. N. LAUDER,
JACOB JOHANN,
H. N. SPRAGUE,
Committee.

Driving Wheel Brakes—To What Extent is Their Use Advisable, and Best Method of Application.

J. DAVIS BARNETT,
H. A. WHITNEY,
F. M. WILDER,
Committee.

Balanced Slide Valves.

CHARLES BLACKWELL,
JAMES MEEHAN,
E. M. ROBERTS,
Committee.

Best Material and Form of Construction for Locomotive Guides and Cross-heads.

A. J. CROMWELL,
WILLIAM SWANSTON,
A. BECKETT, B. & O. R. R.,
Committee.

Best Plan of Removing, Cleaning, and Resetting Flues.

CLEM. HACKNEY,
A. W. SULLIVAN,
G. H. PRESCOTT,
Committee.

Tools and Machinery.

D. A. WIGHTMAN,
A. J. PITKIN,
F. B. MILES,
Committee.

Associate Members to Read Papers.

ROBERT GRIMSHAW, New York.
JOHN A. COLEMAN, Providence, R. I.

mmer Blow Test of Locomotives.

WILLIAM WOODCOCK,
THOS. L. CHAPMAN,
COLEMAN SELLARS,
ANGUS SINCLAIR,
F. W. DEAN,
Committee.

on Fund, Printing, and General Supervisory Committee.

J. DAVIS BARNETT,
WILLIAM WOODCOCK,
JACOB JOHANN,
GEO. RICHARDS,
J. H. SETCHEL.

nding Committee on Subjects.

J. M. BOON,
T. B. TWOMBLY,
CHARLES BLACKWELL.

mittee of Arrangements for Nineteenth Annual Meeting.

J. N. LAUDER,
GEO. RICHARDS,
H. L. LEECH.

CONSTITUTION.

As Amended at the Fourteenth Annual Meeting, Providence, June 14, 1881.

PREAMBLE.

We, the undersigned Railway Master Mechanics, believe that the interests of the Companies by whom we are employed, may be advanced by the organization of an association which shall enable us to exchange information upon the many important questions connected with our business. To this end do we establish the following

CONSTITUTION.

ARTICLE I.

SECTION 1. The name and style of this Association shall be the AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

ARTICLE II.

SEC. 1. The officers of the Association shall be a President, a First and Second Vice-President, a Secretary, and a Treasurer.

SEC. 2. The above-named officers shall be elected separately, by ballot, at each Annual Convention, and a majority of all votes cast shall be necessary to a choice.

SEC. 3. Two Tellers shall be appointed by the President to conduct the election and report the result.

ARTICLE III.

SEC. 1. It shall be the duty of the President to preside in the usual manner at all the meetings of the Association, and approve all bills against the Association for payment by the Treasurer.

SEC. 2. It shall be the duty of the Vice-Presidents, according to rank, to perform the duties of the President in his absence from the meetings of the Association.

SEC. 3. In case of the absence of both President and Vice-Presidents, the members present shall elect a President *pro tempore*.

SEC. 4. It shall be the duty of the Secretary to keep a full and correct record of all transactions at the meetings of the Association; to keep a record of the names and places of residence of all members of the Association, and the name of the road they each represent; to receive and keep an account of all money paid to the Association, and at the close of each meeting deliver the same to the Treasurer, taking his receipt for the amount; to receive from the Treasurer all paid bills, giving him a receipted statement of the same.

SEC. 5. It shall be the duty of the Treasurer to receive all money from the Secretary belonging to the Assciation, to receive all bills against the Association, and pay the same, after having the approval of the President; to deliver all paid bills to the Secretary at the close of each meeting, taking a receipted statement of the same; to keep an accurate book account of all transactions pertaining to his office.

ARTICLE IV.

SEC. 1. The following persons may become members of the Association by signing the Constitution, or authorizing the President or Secretary of the Association to sign for them, and pay the initiation fee of one dollar. Any persons having charge of the mechanical department of a Railway known as "Superintendents," or "Master Mechanics" or "General Foremen," the names of the latter being presented by their superior officers for membership, also two Mechanical Engineers, or the representative of each Locomotive Establishment in America.

SEC. 2. Civil and Mechanical Engineers, and others whose qualifications and experience might be valuable to the Association, may become Associate Members by being recommended by three Active Members. Their names shall then be referred to a committee, which shall report to the Association on their fitness for such membership. Applicants to be elected by ballot at any regular meeting of the Association, and five dissenting votes shall reject. The number of Associate Members shall not exceed twenty. Associate Members shall be entitled to all the privilege of active members, excepting that of voting.

SEC. 3. Any person who has been or may be duly qualified, and signs, or causes to be signed, the Constitution, as member of the Association, remains as such until his resignation may be voluntarily tendered.

SEC. 4. All members of the Association will be liable for such dues as may be necessary to assess to defray the expenses of the Association, and any member who shall be two years in arrears for annual dues

shall have his name stricken from the roll, and be duly notified of the same by the Secretary.

ARTICLE V.

SEC. 1. The regular meeting of the Association shall be held annually on the third Tuesday in June.

SEC. 2. Regular meetings shall be held at such place as may be determined upon by a majority of the members present at the previous meeting.

SEC. 3. An adjourned meeting may be held at any time and place that a majority of the members present at any meeting may elect

SEC. 4. The regular hours of sessions shall be from 9 o'clock A. M. to 2 o'clock P. M.

SEC. 5. During the business sessions no communications shall be received or acted upon other than those pertaining to the business of the Association.

SEC. 6. At this, the Thirteenth Annual Meeting, the President shall appoint three members to constitute a standing committee to recommend to the Association at each Annual Meeting subjects for discussion at each succeeding Convention, one member for three years, one for two years, and one for one year, designating the term of each member, and each succeeding year one member of said committee shall be elected by the As ociation by ballot.

The said committee shall, at one o'clock on the second day of each Annual Convention, report to the Association subjects for discussion at the succeeding Convention.

At 7:30 o'clock of the second day of each Annual Convention there shall be a joint meeting of said committee with an advisory committee, composed of the officers of the Association, which joint committee shall, at ten o'clock on the morning of the third day of each Annual Convention, nominate to the Association the members of the several committees upon said subjects. Said joint committee shall nominate, upon subjects which require reports, from various parts of the country, full committees of three or five, which committees shall be called committees of research, and shall have power to solicit reports from not all but a part of the members of the Association upon such subjects; and upon other subjects said joint committee shall nominate simply the chairman of the committees, who shall have power to select their own associates upon such committees, which shall be called committees of investigation; said joint committee shall also nominate two Associate Members to read papers at the succeeding Annual Meeting.

All committees so appointed, whether of research or investigation,

shall meet at four o'clock on the afternoon of the third day of each Annual Convention to plan and divide its work for the ensuing year.

Each committee on research shall, on or before the first day of July of each year, send to the Secretary of the Association a circular letter setting forth the character of reports desired from the members, together with a list of persons to whom said letter shall be sent; and the Secretary shall immediately print and mail the same to such members, with an earnest request that, as a matter of courtesy, full replies thereto shall be sent on or before the first day of April following to the chairman of such committees.

Each committee, whether of research or of investigation, shall, if possible, meet pursuant to the call of its chairman, during the second week in April of each year, for the preparation of its report, which, in the absence of such meeting, shall be prepared by the chairman, and shall immediately forward the same to the Secretary of the Association, by whom it shall be printed and supplied to the members at the commencement of each Annual Convention.

Each report of such committees shall name the members of the Association from whom replies to said circular letters were requested but not received, on or before the first of April as aforesaid.

ARTICLE VI.

SEC. 1. This Constitution may be amended at any regular meeting of the Association by two-thirds vote of the members present.

Resolution Passed at the Sixth Annual Meeting, Baltimore, Maryland, May, 1873.

Resolved, That no expense shall be incurred by committees except by the unanimous consent of the General Supervisory Committee, given in writing to the Chairman of said Committee, stating the amount to be expended.

Resolution on Boston Fund, Passed at the Eighth Annual Meeting, New York, May, 1875.

Resolved, That the Boston Fund, amounting now, with accrued interest, to $3,620, be invested in Government securities to be selected by the duly appointed Trustees, and not to be disturbed for the purpose of expenditure unless authorized by the majority of members present in open Convention, and then only after due notice of a motion to expend the same has been given at the session immediately preceding;

and that the interest accumulating shall every year be invested in the same manner as the principal, and a full account of the same be duly reported with other financial statements.

Resolution Adopted at the Ninth Annual Meeting.

Resolved, That members of the Association who have been in good standing for a period of not less than five years, and who through age or other cause cease to be actively engaged in the mechanical departments of railroad service, may, upon the unanimous vote of the Association, be elected "Honorary Members," who shall have their dues remitted and be entitled to all the privileges of regular members except that of voting.

ORDER OF BUSINESS.

1. Reading the Minutes of the previous meeting.
2. Calling the Roll of Members.
3. Signing the Constitution.
4. Report of Secretary.
5. Report of Treasurer.
6. Report of Committees appointed at a previous meeting.
7. Election of Officers.
8. Appointment of a Committee to suggest Subjects for Consideration.
9. Appointment of Miscellaneous Committees; Finance, Printing, and Place of Holding Next Annual Meeting.
10. Report of Committee to suggest Subjects for Consideration.
11. Appointment of Committees to report upon Subjects suggested for Consideration.
12. Unfinished Business.

R. WELLS,
JAMES SEDGLEY,
J. DAVIS BARNETT, *Committee.*
GEO. RICHARDS,
J. H. SETCHEL,

NAMES AND ADDRESS OF MEMBERS.

NAME.	ROAD.	ADDRESS.
Anderson, H.,	204 Dearborn Street,	Chicago, Ill.
Anderson, J. H.,	N. Y. B. & P.,	Providence, R. I.
Anderson, E. D.,	Ill. Cent.,	Macomb City, Miss.
Barton, J. C.,	H. & C. W.,	Hartford, Conn.
Bryan, H. S.,	C. & I.,	Aurora, Ill.
Boon, J. M.,	N. Y. W. S. & B.,	Frankfort, N. Y.
Bushnell, R. W.,	B. C. R. & N.,	Cedar Rapids, Ia.
Brastow, L. C.,	C. R. R. of N. J.,	Wilkesbarre, Pa.
Brooks, H. G.,	Brooks' Loco. Works.	Dunkirk, N. Y.
Barnett, J. Davis,	Midland R. R.,	Port Hope, Ont.
Black, John,	C. H. & D.,	Lima, O.
Blackwell, R. C.,	D. & H. C. Co.,	Albany, N. Y.
Bissett, John,	W. & W.,	Wilmington, N. C.
Briggs, R. H.,	C. O. & S. W.,	Elizabethtown, Ky.
Bradley, S. D.,	G. R. & I.,	Grand Rapids, Mich.
Brigham, L. L.,	Passumpsic,	Lyndonville, Vt.
Brownell, F. G.,	P. & L.,	Burlington, Vt.
Berry, L. D.,	D. M. O. & S.,	Osceola, Ia.
Brokaw, W. I.,	St. L. H. & K.,	Hannibal, Mo.
Bothwell, James,	C. & N. W.,	Baraboo, Wis.
Brooks, L. R.,	Lima Iron Works,	Birmingham, Ala.
Blackwell, Charles,		Roanoke, Va.
Bosworth, B. C.,	C. V.,	Canton, O.
Bean, John,	Connotton Valley,	Canton, O.
Beekert, A.,	B. & O.,	Mt. Clair, Md.
Cullen, James,	N. & C.,	Nashville, Tenn.
Campbell, E. A.,	E. & W. T.,	Houston, Texas.
Campbell, John,	D. V.,	Delano, Pa.
Colby, G. H.,	B. & A.,	Boston, Mass.
Cascaddin, R. O.,	C. R. I. & P.,	Trenton, Mo.
Chapman, N. E.,	Midvale Steel Co.,	333 Walnut St., Phila., Pa.
Chapman, J. W.,	N. Y. L. E. & W.,	Hornellsville, N. Y.
Chapman, Thos. L.,	C. & O.,	Richmond, Va.
Coolidge, Geo. A.,		Charlestown, Mass.

NAME.	ROAD.	ADDRESS.
Clark, David, ...	L. V., ...	Hazleton, Pa.
Clark, Peter, ...	Northern, ...	Toronto, Canada.
Cooper, H. L., ...	L. E. & W., ...	Lafayette, Ind.
Cook, James, ...	Danforth & Cook's L. W.,	Patterson, N. J.
Cushing, Geo., ...	N. P., ...	St. Paul, Minn.
Crockett, John F., . .	B. L. & N., ...	Boston, Mass.
Colburn, Richard, ...		Norwich, Conn.
Clifford, J. G., ...	L. & N., ...	Bowling Green, Ky.
Cook, John S., ...	Georgia, ...	Augusta, Ga.
Cook, Allen, ...	C. & E. I., ...	Danville, Ill.
Carson, M. T., ...	Mobile & Ohio, ...	Whistler, Ala.
Collier, M. Lamar, . .	W. & A., ...	Atlanta, Ga.
Cromwell, A. J., . . .	M. of M. B. & O. R. R., .	Mt. Clare, Md.
Davis, N. L., ...	R. & V., ...	Rutland, Vt.
Devine, J. F., ...	W. & W., ...	Wilmington, N. C.
Dripps, W. A., ...	3224 Walnut Street, . . .	Philadelphia, Pa.
Domville, C. K., . . .	G. W. of Canada, ...	Hamilton, Canada.
Downe, George, . . .	Government R. R., ...	Sidney, Australia.
Dotterer, D. H., . . .	A. T. & S. F., ...	Raton, New Mexico.
Evans, Edward, . . .	C. W. & B., ...	Chillicothe, O.
Ellis, Matthew, . . .	C. St. P. M. & O., ...	St. Paul, Minn.
Eblen, James, ...	L. R. & Ft. S.	Argenta, Ark.
Ellis, W. H., ...	P. & R., ...	Catawissa, Pa.
Eckford, James, ...		Bellevue, O.
Eastman, A. G., . . .	S. E., ...	Farnham, Ontario.
Ennis, W. C., ...	N. Y. S. & W., ...	Wortendyke, N. J.
Elliott, Henry, ...		East St. Louis, Ill.
Foss, J. M., ...	C. V., ...	St. Albans, Vt.
Fuller, Wm., ...	N. Y. P. & O., ...	Cleveland, O.
Finlay, L., ...		Little Rock, Ark.
Foster, W. A., ...	W. & M. Div. F. R. R., .	Fitchburg, Mass.
Fowle, I. W., ...	V. & M. & N. O. & N. E.,	Meridian, Miss.
Ferguson, G. A., . . .	B. C. & M., ...	Lake Village, N. H.
Fenwick, A., ...	Green Bay, Winona, St. P.	Fort Howard, Wis.
Griffith, Fred. B., . .	D. L. & W., ...	East Buffalo, N. Y.
Greenwood, A. W., . .	E. B. T., ...	Orbisonia, Pa.
Gates, G. W., ...	Western of N. C., ...	Salisbury, N. C.

NAME.	ROAD.	ADDRESS.
Griggs, Albert,	P. & W.,	Providence, R. I.
Gordon, H. D.,	P. W. & B.,	Wilmington, Del.
Graham, Chas. D.,	D. L. & W.,	Kingston, Pa.
Gordon, James T.,	Concord R. R.,	Concord, N. H.
Graham, J. S.,	L. S. & M. S.,	Buffalo, N. Y.
Gilmore, W. L.,	L. S. & M. S.,	Cleveland, O.
George, Nathan M.,	D. & W.	Danbury, Conn.
Galloway, A.,	Cleve. & Marietta R. R.,	Cambridge, O.
Gilson, Gregg D.,	Hemmingway & Brown,	75 State St., Boston, Mass.
Hinman [illegible]. L.,	Brooks' Loco. Works,	Dunkirk, N. Y.
Headden, John,	Rogers' Loco. Works,	Patterson, N. J.
Harding, B. R.,	R. & G.,	Raleigh, N. C.
Hollister. James D.,	F. S.,	Palatka, Fla.
Ham, C. T.,	Buffalo Steam Gauge Co.,	Rochester, N. Y.
Hewitt, John,	M. P.,	St. Louis, Mo.
Hodgman, S. A.,		Wilmington, Del.
Haynes, O. A.,	St. L. I. M. & So.,	St. Louis, Mo.
Hall, Sen. Don Diago,	Supt. Loco. Dept. F. C.,	Santiago, Chili, S. A.
Haggett, J. C.,	D. A. V. & P.,	Dunkirk, N. Y.
Hanson, C. F.,	G. W. of Canada,	London, Ontario.
Hackney, Geo.,	A. T. & S. F.,	Topeka, Kan.
Hackney, C.,	A. T. & S. F.,	Topeka, Kan.
Howison, N. W.,	C. & R.,	Mt. Savage, Md.
Henny, John J.,	N. Y. N. H. & H.,	New Haven, Conn.
Henny, J. B.,	Supt. M. P. N. Y. & N. E.,	Boston, Mass.
Howe, Geo. E.,	St. J. & L. C.,	St. Johnsbury, Vt.
Hatswell, T. J.,	F. & P. M.,	East Saginaw, Mich.
Hovey, J. P.,		Rochester, N. Y.
Horniblow, J. P.,	Government R. R.,	Queensland, Australia.
Hall, J. W.,	L. & N.,	Montgomery, Ala.
Hickey, John,	M. L. S. & W.,	Manitowoc, Wis.
Hoffecker, W. L.,		Vincennes, Ind.
Holman, W. L.,	P. & E.,	Renova, Pa.
Harrison, W. H.,	B. & O.	Newark, O.
Inness, Thos. B.,	115 Broadway,	New York City.
Johnson, J. B.,	N. C.,	Helena, Ark.
Johann, Jacob,	C. & A.,	Huntington, Ind.

NAME.	ROAD.	ADDRESS.
Jeffery, E. T.,	Illinois Central,	Chicago, Ill.
Jacques, Richard,	Hemmingway & Brown,	75 State St., Boston, Mass.
Kielmer, John T.,	812 East York Street,	Philadelphia, Pa.
Kinsey, J. I.,	L. V.,	Easton, Pa.
Keeler, Sanford,	F. & P. M.,	East Saginaw, Mich.
Lythgoe, Joseph,	R. I. Loco. Works,	Providence, R. I.
Leeds, Pulaski,	L. & N.,	Louisville, Ky.
Losey, Jacob,	Steam Forge Co.,	Louisville, Ky.
Lauder, J. N.,	Old Colony,	Boston, Mass.
Leech, H. L.,	No. 1 Rollins St.,	Boston, Mass.
Lannon, William,	House of Representatives,	Washington, D. C.
Lewis, W. H.,	D. L. & W.,	Kingsland, N. J.
Levis, J. M.,	S. M. & M.,	Marion, Ala.
Lape, John R.,	T. P.,	Big Springs, Texas.
Lowe, Geo. W.,	C. & N. W.,	Clinton, Ia.
Lockwood, W. E.,	251 S. Third St.,	Philadelphia, Pa.
Mast, F. M.,	L. E. & St. L.,	Evansville, Ind.
Millholland, James A.,	G. C. & C.,	Cumberland, Md.
Maynes, W. C.,	C. & E. I.,	Chicago, Ill.
Meehan, James,	C. N. O. & T. P.,	Ludlow, Ky.
McGrayel, John M.,	D. M. & F. D.,	Grand Junction, Ia.
Middleton, Harvey,	L. & N.,	Louisville, Ky.
McCune, J. C.,	Sonora,	Guymas, Mexico.
Mulligan, J.,	Conn. River,	Springfield, Mass.
Mitchell, A.,	L. V.,	Wilkesbarre, Pa.
Morse, G. F.,	Portland Loco. Works,	Portland, Me.
McGlenn, James,	Carolina Central,	Laurinburg, N. C.
McKenna, J.,	I. P. & C.,	Peru, Ind.
McCrum, J. S.,	M. R. Ft. S. & G.,	Kansas City, Mo.
McVay, John,		Chattanooga, Tenn.
Morrell, J. E.,	C. R. I. & P.,	Davenport, Ia.
Miller, W. H.,	Transfer & Stock Yard Co.,	Indianapolis, Ind.
Minshall, E.,	N. Y. O. & W.,	Middleton, N. Y.
McFarland, W.,	St. P. & D.,	St. Paul, Minn.
Montgomery, Wm.,	N. J. Southern,	Manchester, N. J.
Millen, Thomas,	N. Y. C. & N.,	New York City.
Mills, C. W.,	R. & P.,	Rochester, N. Y.

NAME.	ROAD.	ADDRESS.
Noble, L. C.,	H. & T. C.,	Houston, Texas.
Olcott, H. P.,	A. T. & S. F.,	Deeming, New Mex.
Ortton, John,	N. Y. C.,	East Albany, N. Y.
Paxson, L. B.,	Philadelphia & Reading,	Reading, Pa.
Petrie, Ira,	J. & S. E.,	Jacksonville, Ill.
Pringle, R. M.,	St. L. & C. Short Line,	St. Louis, Mo.
Perry, F. A.,	C. & A.,	Keene, N. H.
Perrin, P. J.,	Taunton Loco. Works,	Taunton, Mass.
Prescott, G. H.,	T. H. & I.,	Terre Haute, Ind.
Prescott, G. W.,	T. & St. L.,	25 S. 4th St., St. Louis, Mo.
Purves, T. B.,	B. & A.,	East Albany, N. Y.
Place, T. W.,	I. C.,	Waterloo, Ia.
Porter, J. S.,	I. B. & W.,	Sandusky, O.
Patterson, J. S.,	C. I. St. L. & C.,	Cincinnati, O.
Parry, C. T.,	Baldwin Loco. Works,	Philadelphia, Pa.
Player, John,	Central of Iowa,	Marshalltown, Ia.
Pillsbury, Amos,	Eastern,	Boston, Mass.
Pitkin, A. J.,	Schenectady L. W'ks,	Schenectady, N. Y.
Richardson, E.,	S. V.,	Greenville, Pa.
Ranson, Thos. W.,	I. & St. L.,	Mattoon, Ill.
Richards, Geo.,	B. & P.,	Boston, Mass.
Robb, W. D.,	L. & N.	Pensacola, Fla.
Reynolds, G. W.,		Taunton, Mass.
Ross, Geo. B.,	112 Liberty St.,	New York City.
Renshaw, W.,	I. C.,	Chicago, Ill.
Roberts, E. M.,	Ashland Coal & Min'g Co.,	Ashland, Ky.
Rennell, Thos.,	M. & L.,	Argenta, Ark.
Richardson, R. M.,	St. L. I. M. & S.,	Little Rock, Ark.
Robertson, W. J.,	Cent. Vt. R. R.,	St. Albans, Vt.
Stone, W. A.,	N. Y. & N. E.,	Norwich, Conn.
Sanborn, C. A.,	T. H. & I.,	East St. Louis, Mo.
Stokes, J. W.,	O. & M.,	Pana, Ill.
Sullivan, A. W.,	I. C.,	Chicago, Ill.
Smith, Howard M.,	R. & D.,	Alexandria, Va.
Sanborn, J. M.,	L. S. & M. S.,	Norwalk, O.
Scruten, C. E.,	E. & W. of Ala.,	Cedartown, Ga.
Sellars, Morris,	No. 6 Ashland Block,	Chicago, Ill.

NAME.	ROAD.	ADDRESS.
Schlacks, Henry,	Ill. Cent.,	Chicago, Ill.
Smith, W. T.,	C. & O.,	Huntington, W. Va.
Smith, Allison D.,	Government R. R.,	New Zealand.
Strode, James,	N. C.,	Elmira, N. Y.
Stearns, W. H.,	Conn. River,	Springfield, Mass.
Shaver, D. O.,	Pennsylvania,	Pittsburgh, Pa.
Setchel, J. H.,	Brooks' Loco.Works,	Dunkirk, N. Y.
Sprague, H. N.,	E. K. Porter & Co.,	Pittsburgh, Pa.
Sanborn, A. J.,	Ohio Southern,	Springfield, O.
Smith, Wm.,	Boston & Maine,	Boston, Mass.
Stevans, G. W.,	L. S. & M. S.,	Cleveland, O.
Selby, W. H.,		Moberly, Mo.
Simonds, G. B.,		Sedalia, Mo.
Sitton, B. J.,	E. T. V. A. & G. A.,	Knoxville, Tenn.
Stewart, O.,	Fitchburg,	Charlestown, Mass.
Stinard, F. A.,	N. Y. & Greenwood Lake,	Pompton Junc., N. Y.
Swanston, Wm.,	J. M. & I.,	Indianapolis, Ind.
Steel, W. J.,		Nashville, Tenn.
Short, Wm. A.,	Ogdensb'g & Lake Champ.,	Malone, N. Y.
Smith, Wm. F.,		Carlin, Nevada.
Tandy, H.,	Canada Loco. Works,	Kingston, Ont.
Twombly, F. M.,	Old Colony,	Boston, Mass.
Twombley, T. B.,	C. R. I. & P.,	Chicago, Ill.
Turreff, W. F.,	C. C. C. & I.,	Cleveland, O.
Taylor, J. K.,	Boston & Lowell,	Boston, Mass.
Thumser, John,		Seymour, Ind.
Thow, Wm.,	S. A.,	Adelaide, Australia.
Tregelles, Henry,	N. Y. L. E. & W.,	Salamanca, N. Y.
Teal, S. A.,	S. C. & P.,	Missouri Valley, Ia.
Thomas, W. H.,	E. T., Va. & Ga.,	Knoxville, Tenn.
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Thompson, W. A.,	M. H. & O.,	Marquette, Mich.
Thomas, C. F.,	C. & O.,	Richmond, Va.
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Wakefield, S. W.,	C. R. I. & Pac.,	Keokuk, Ia.
Watrous, Geo. C.,	D. L. & N.,	Iona, Mich.

NAME.	ROAD.	ADDRESS.
West, Geo.,	N. Y. W. S. & B.,	East Buffalo, N. Y.
Walsh, Thomas,	L. & N.,	Louisville, Ky.
Warren, W. B.,	I. B. & W.,	Indianapolis, Ind.
Wells, Reuben,	L. & N.,	Louisville, Ky.
Wiggins, J. E.,	S. P. & T. N.,	Marshall, Texas.
Woodcock, W.,	C. R. R. of N. J.,	Elizabethport, N. J.
Williams, E. H.,	Baldwin Loco. Works,	Philadelphia, Pa.
Weaver, D. L.,	C. O. & S. W.,	Elizabethtown, Ky.
White, Philip,		Wellsville, O.
Wilder, F. M.,	N. Y. L. E. & W.,	Susquehanna, Pa.
Wightman, D. A.,	Pittsburgh Loco. Works,	Pittsburgh, Pa.
White, C. W.,	L. & N.,	Birmingham, Ala.
White, J. F.,	I. C.,	Water Valley, Miss.
Watts, Amos,	T. P.,	Marshall, Texas.
Williams, C. G.,	C. R. R. of N. J.,	Communipaw, N. J.
Whitney, H. A.,	Intercolonial,	Moncton, N. B.
White, A. M.,	N. Y. Loco. Works,	Rome, N. Y.
Williams, Richard,		Dunkirk, N. Y.

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Dean, F. W.,		East Taunton, Mass.
Evans, W. W.,	Sans Soucia, near	New Rochelle, N. Y.
Forney, M. N.,	73 Broadway,	New York City.
Hill, Jno. W.,		Cincinnati, O.
Lilly, J. O. D.,		Indianapolis, Ind.
Lyne, Lewis F.,	307 Grove St.,	Jersey City, N. J.
Miles, F. B.,		Philadelphia, Pa.
Smith, Willard A.,	Chicago Review,	Chicago, Ill.
Gordon, Alex.,	Niles Tool Works,	Hamilton, O.
Sinclair, Angus,	187 Dearborn St.,	Chicago, Ill.
Wheelock, Jerome,		Worcester, Mass.

HONORARY MEMBERS.

Britton, H. M.,	R. W. & O.,	Oswego, N. Y.
Dripps, Isaac,	3405 Walnut St.,	Philadelphia, Pa.
Peddle, C. R.,	T. H. & I.,	Terre Haute, Ind.
Robinson, W. A.,		Hamilton, Canada.
White, J. L.,		Danville, Ill.
Sedgely, James,		Cleveland, O.
Philbrick, J. W.,		Waterville, Me.
Cummings, Samuel.		Boston, Mass.
Eddy, Wilson,		Springfield, Mass.
Town, H. A.,		Brainerd, Minn.

OBITUARY.

John Hughes Flynn.

The late John Hughes Flynn of Atlanta, Ga., stood in the front rank of the self-made men of that city. He was a man of exceptional talents, great forces of character, and spotless integrity. Such a life is at once an inspiration, and a hope to the industrious and ambitious youths of the land, and an outline of its works and results cannot fail to interest even the casual reader.

Mr. Flynn was born in Philadelphia, Penn., in the year 1828. His parents were natives of Ireland, and were people of intelligence and character. The maternal side belonged to the Gales and Hollands, of Queens County. The Gales were of the church of England, and filled many positions of honor and trust. To this family belonged Sir Parnell Gale, one of the most notable men of his day. After the Irish rebellion in which the Flynns took sides with the patriots, they came to America, settling in the neighborhood of Philadelphia.

The subject of this sketch found himself at an early age, compelled to depend upon his own resources. His parents were in very moderate circumstances, and were able to give young Flynn the benefits of only an ordinary English education. One of the distinguishing characteristics of the boy, however, was rare common sense, and he thoughtfully and generously insisted upon contributing his mite to the support of the family. He was allowed therefore to enter a factory at the early age of twelve, filling the position of errand boy, and making himself generally useful. From this place he passed into a printing office, where his quick intelligence enabled him to utilize every opportunity of acquiring useful knowledge. Next came a brief period of schooling, and the manly youth then began life in earnest. Having an ardent desire to be come a first-class machinist, he entered the large establishment of the "Southwork Foundery and Machine Works." He spent several

years here and in the locomotive works of William Norris, at that time one of the principal works of the kind in the country. Later he was engaged with Haywood and Snyder at Pottsville, Pa., and while with them erected and put in operation the machinery of the Phoenixville Rolling Mill, the second mill for rolling T rail erected in this country, or rather the United States. Some years were then spent in the employment of the Niles Brothers of Cincinnati, and in the service of the Madison and Indiana R. R., then the only road in the above mentioned state.

Mr. Flynn came to Atlanta when it was in its infancy, just emerging from the woods. His recommendations and frank and winning ways at once secured favorable recognition, and a position was given him on the important line of the Western and Atlantic R. R., where his ability was so conspiciously manifested, that after several years' faithful service he was promoted to the place of master mechanic of the shops of the road, located in Atlanta.

Shortly before this promotion Mr. Flynn married Miss Kate Dougherty, an estimable young lady, the daughter of Mr. Daniel Dougherty, one of the founders of the city. As his courtship illustrates the fine blending of sentiment and romance with the more solid elements of his character, a brief reference to it will be proper. It was while running a train between Atlanta and Ringgold, Ga., that he became somewhat annoyed at the mischievous conduct of a young lady who threw stones at the train every time it passed her father's house. Mr. Flynn finally decided to put a stop to this conduct, and stopped the train one day to lay his grievance before the merry maiden's parents, he thus obtained a nearer view of Miss Kate, and as a mutually favorable impression was made, courtship and marriage followed.

With the Western and Atlantic road Mr. Flynn remained, with the exception of short intervals, for the long period of forty years. Under the pressure of heavy work and grave responsibilities, his unvarying kindness and firmness, his fine executive ability, and his faithful devotion to duty, won the respect and admiration of all. No man connected with the road was more loved and honored. He stood by Atlanta through the fiery ordeal, into which she was cast by the fortunes of war, and after witnessing her destruction by the torch, bravely and hopefully devoted his energies to her re-

habilitation. Mr. Flynn was fitted to fill and adorn many positions in the various walks of life; his connection with the substantial wholesale house of Stephens & Flynn, made his name a power in commercial circles. Relying upon his solid judgment and patriotism, his fellow citizens sent him to the city council and the constitutional convention of 1867. In both of these bodies he rendered valuable services and ranked among the ablest members. On the board of education, as a director of the citizens bank, and as chairman of the building committee of the Catholic church, of which he was a true and a devoted member, his qualities of leadership, and his practical foresight were of inestimable value. Towards the close of his busy and useful life, he served two terms as a director of the Young Men's Library Association, and filled several terms as president of that body. The energy with which he devoted himself to the building up of this, illustrates one of the most admirable phases of his character, his interest in the advancement of young men, and in the cause of popular education. At the convention of the Master Mechanics' Association, held at Long Branch, in July, 1884, he was elected to preside over the deliberations of that body for one year. He was among the first of the southern master mechanics to join the Association, and remained a most valuable member until his death.

The death of this noble hearted and public spirited citizen, from abcess of the brain on the 1st of October, 1884, carried sorrow to a wide circle of friends and acquaintances throughout the country. At the time of his death he was fifty-six years old, in the prime of life, and his magnificent physique had inspired the hope that he was destined to live for many long years. He was a man of fine presence, with a massive head, an intellectual brow, regular features, and kind eyes beaming with intelligence and trinkling with quiet humor. Apart from his official and public relations, he found time to serve the interest of his family and friends, and in the family circle there was never a more loving or more beloved husband and father. Indeed it may be said that in all the relations of life, as an official representative of his people, and the head of a family, John Hughes Flynn was a model citizen, and a peerless Christian gentleman. The bereavement of his widow and son and daughters was shared by the people of Atlanta, and the large and

sorrowing assemblage that stood around his grave in Oakland Cemetary, felt that of all the noble dead sleeping there, there was not one in that silent city that had left behind him a brighter example, a more honored memory, or a more stainless name. The young men of the country may well follow in the footsteps of this self-made man. His life should remind them that all the prizes of a successful career are within the reach of those who courageously and faithfully pursue the pathway of duty; steadfastly and manfully fighting the good fight to the end.

M. LAMAR COLLIER, Chairman.
JOHN F. DIVINE,
M. M. PENDLETON.

Mr. James Cooke,

Well known as a locomotive builder of skill and experience, died August 2nd, 1883, in the Adirondacks, where he had gone for his health. Mr. Cooke was still quite a young man, his age being only 46 years. He was born in Matteawan, New York, in 1837, but came to Patterson, N. J., as a boy, and there learned his trade in the locomotive shops of the newly established firm of Danforth, Cooke & Co., in which his brother, the late John Cooke, was Superintendent.

In 1858, when just of age, he went to Scranton, Pa., where he remained for ten years in the shops of the Delaware, Lackawanna & Western R. R., rising gradually to be master mechanic of the road. He left that position in 1868, and returned to Patterson, where he was appointed superintendent of the Danforth (now the Cooke) Locomotive and Machine Works, and continued in that position until in the year 1881, he was chosen President of the Company to succeed his brother John Cooke, who had died a short time before. The change of position made little difference in his work however, as he still continued the active Superintendent of the works when his health permitted. Three (3) years ago when the erecting and some other shops of the company were destroyed by fire, Mr. Cooke caught a severe cold which settled on his lungs, and from the effects of which he never fully recovered. He had several times visited the Adirondacks, in the hope of benefitting

his health. The immediate cause of his death, which was sudden and unexpected, was hemorrhage of the lungs. He left a wife and three children. Mr. Cooke was the youngest of four brothers. Their father, Mr. Watts Cooke, Sr., was for many years pattern maker in the shops of the Rogers Locomotive Works, and was considered a mechanic of exceptional skill. Mr. James Cooke was not one of the pioneer builders who made the American locomotive, he belonged rather to the second generation, who were not called upon to originate, as were Thomas Rogers, Matthias W. Baldwin, Wm. Mason, and their contemporaries. He was one of those whose place it was to follow in the steps of the fathers, improving what they had made, and seeing that their work was equal to and kept pace with the increasing demand upon them.

As the executive head of a large shop, he was active, pushing, and capable, controlling well the works under his charge, and keeping up with the times. His death, while still a man in the prime of life, will be mourned by his many friends, and by the members of the American Railway Master Mechanics' Association of which he was an honored member.

WM. WOODCOCK,
JOHN HEADDEN,
E. H. WILLIAMS.
Committee.

John C. Ellis.

John C. Ellis died of heart disease in Schenectady, N. Y., on the 4th of October, 1884, aged 48 years.

He was born at Sandy Hill, N. Y., on October 6, 1836. He came to Schenectady with his parents and made that city his home until his death. He learned the machinist trade at the Schenectady Locomotive Works, and afterwards assumed in part the management of the Works. On the death of his father, the late William Ellis, which occured in 1864, John C. Ellis was made President of the Schenectady Locomotive Works, which position he held until 1876, when he retired from active business, although he still retained a large interest in the Company to which he continued to

give much attention; his advice and counsel being frequently sought by the present managers. He represented his county in the state legislation in 1866, but he never seemed to be ambitious of notoriety in politics. He was known as a generous, kind hearted man, and many of the poor people of Schenectady will always cherish his memory with gratitude for his kindness.

His widow and one son survive him.

M. N. FORNEY,
A. J. PITKIN.
Committee.

J. Augustus Durgin,

A member of this Association, and late Superintendent of Motive Power of the New York, Providence and Boston Railroad, died Nov. 8, 1884, from injuries received by being crushed between two passenger cars while standing upon the track, in Providence, R. I.

Mr. Durgin was born in Madbury, N. H., August 31, 1834. In 1855 he was employed in the repair shop of the Pemberton Mills, at Lawrence, Mass., and later in the locomotive shops of Hinkley and Drury, in Boston. In 1856 he went to Amboy, Ill., serving as fireman on the Illinois Central R. R. for about a year, and on the Michigan Central R. R. as locomotive engineer for a few months. Early in 1858, he returned to Boston and entered the service of Mr. John Stevens, architect, being employed as draughtsman. He remained there until 1860, when he accepted a position as draughtsman in the office of Wm. Mason, locomotive manufacturer, at Taunton, Mass. In the latter part of 1861, he became connected with the Erie Railway Co., and was employed as draughtsman in their shops at Peirmont and Jersey City, until 1863, when he went to the Novelty Works, New York City, and remained with that concern until the latter part of 1864, when he entered the service of the Portland Company at Portland, Maine, as assistant superintendent of their works. In 1865, he was appointed superintendent of the Locomotive Works of Edwin Norris, at Lancaster, Penn. In 1868, he assumed charge of the Pittsburgh Locomotive Works as superintendent, retaining that